ENGINEERING

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Milling operations on turbo-jet turbine blades, each machine being fully automatic and dealing with eight blades at a time. (*Nurnberg photograph for* ENGINEERING)

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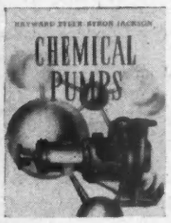

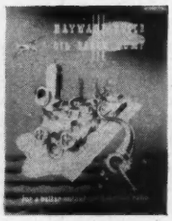

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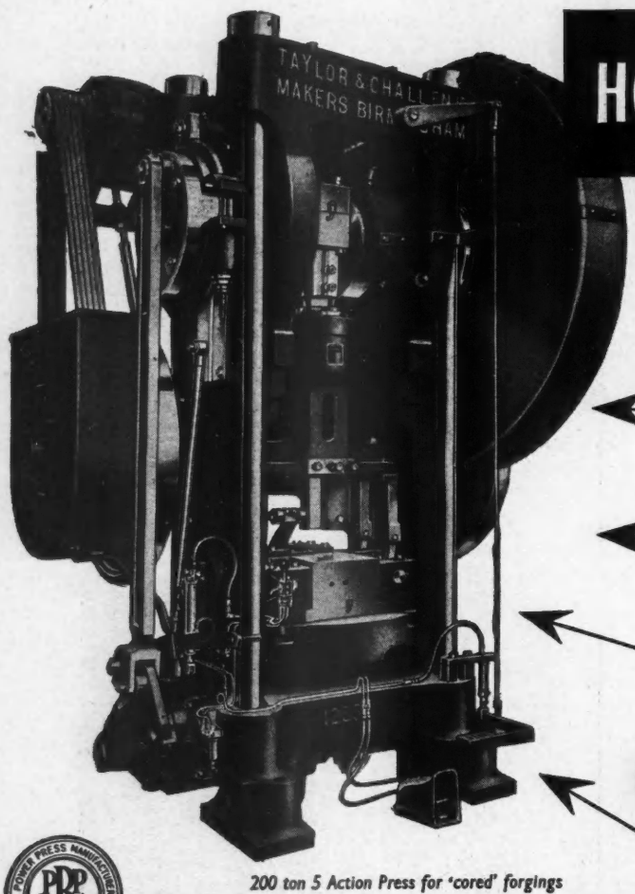

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ENGINEERING Impact

of Fitting Foremen to Modern Industry

DEPENDING on your point of view and the particular works, the term foreman can cover anyone from a charge hand to a superintendent. And though some 10,000 foremen are being appointed in British industry every year there is a recognised shortage of suitable men; also, in certain places there is a shortage not only of suitable men but of any workers willing to accept promotion to the position.

At last week's Foreman Training conference, held in London and organised jointly by the British Institute of Management and ENGINEERING three main causes of the shortage were given. They were listed by Mr. D. B. Beynon, the labour manager of F. H. Lloyd and Company, the steel founders, as the continuing effect of war losses, the loss of status in the job caused by the production planning that was once done on the shop floor being transferred to the pre-planning stage, and the pay differential lacking sufficient value to attract men who are able to earn very nearly as much without the headaches of responsibility.

For industry to be facing difficulties in appointing the best type of foreman means lost time in jobs that are not done as expeditiously as they could have been, lost quality, and all the indirect effects that flow from indifferent labour relations in the factory.

Ambitious

Mr. Beynon outlined a scheme, spread over 18 months, which his company introduced. It amounts to a programme for training potential supervisors. Many more applicants in fact come forward than can be accepted. When the scheme was launched 200 applications were received, of whom 60 were interviewed and only a fraction were wanted for the course.

Essentially, Mr. Beynon looks for a man who is ambitious, wants a career and wishes to accept responsibility and make progress. In this a majority of speakers at the conference concurred. They echoed the opinions found in ENGINEERING's survey of the foreman problem undertaken last year, that the position of the foreman as part of the management team must be recognised.

Taylor Woodrow's group training officer, Mr. W. J. Davies, described the enthusiastic interest shown by building industry foremen, and "trainee foremen" when their training including an element of such studies as the broad economic background of the nation.

Mr. Beynon pointed to the difficulty with the foreman "who knows it all." The man who thinks he has nothing to learn and who is full of resistance to change. Faced with a suggestion that he should go on a course to learn about handling men, such a foreman may refuse to go, saying that having been handling men for 40 years he has nothing to learn.

Among the get-togethers of foremen that his company had found useful were evening talks with a foreman in the chair and with some outside visiting lecturers. A foremen's and supervisors' Saturday conference held in the men's own time with only themselves, their wives and directors of the company present proved popular and was extended by the foremen to become an all-day affair.

The benefits of this kind of activity were acknowledged to be better awareness of what was happening in other departments, exchange of ideas and information on methods, on man-management and on current problems, as well as a general loosening up of restraints on communication between the supervisory staff and between these grades and the senior management.

Occupying an acknowledged position among the leaders in training their foremen, some of the largest construction firms in the United Kingdom have a hard earned body of experience to pass on to others.

Training Building Foremen

From the Taylor Woodrow building firm, whose work is carried on at sites all over Britain and in many overseas territories, Mr. W. J. Davies outlined the seven divisions the firm makes in the training courses for its foremen.

Employing the Welshman's grasp of the graphic phrase, Mr. Davies gave the building industry's image in the public mind as a "killer" industry as a cause for safety instruction being put first in the training plans. Spread over two to three years, there follow external courses on concrete technology (essential for keeping the supervisor technically up-to-date), social psychology and the supervisory elements in foremanship; work study and planning; communication—reading, writing and speaking; and human relations.

Promising workers selected by their companies to be trained for foreman positions are found by training officers to attach great importance to improving their ability to communicate. Workers and foremen both appear to have a commonly found feeling that one of the special attributes of middle and higher management is its ability to speak and write with clarity.

A New Look for the Ruhr

Whichever way you look at it, from plane, train, or the north-south autobahn, the Ruhr is not a pretty sight. The coal and steel industries, in the nature of things, tend to take up more room, make more smoke and produce more heaps of waste material than other industrial operations. There are also still gaping holes left by war damage. The Ruhr authorities have decided that the time has come to give the area a face-lift. The object of the exercise can be stated simply to diversify and beautify the Ruhr.

Under the first heading are a series of measures designed to end the economic dependence of Westphalia-North-Rhine on the basic coal and steel industries of the Ruhr, and to help and encourage the introduction of new industries, such as petrochemicals, electronics and consumer goods of various kinds. All this is to be the responsibility of a publicly owned industrial development corporation. This body has two basic tasks. These are to draw up the plans for a new pattern of industry in the Ruhr and to help both German and foreign firms to set up plants and offices there.

Why has this scheme been put forward now when German industry in general is doing extremely well? The short answer is the fall in demand for Ruhr coal and the arrival in the Ruhr of two oil pipelines.

As one means of encouraging new firms to come to the area the industrial development corporation is modernising and improving the services provided. At the same time in order to brighten up what has always been an extremely depressing region the authorities are proposing to introduce strict anti-pollution laws covering both water and the atmosphere.

of Unscrambling the Liverpool Traffic Jams

At infrequent intervals the chorus of voices urging the immense outlay which an adequate United Kingdom road system would involve is punctuated by a commanding, and intelligible, note.

Occupying this outstanding position is the report of Mott, Hay and Anderson, the London consulting engineers, who have recommended to the Liverpool local authorities not only that there should be a six-lane high-level suspension bridge linking Liverpool with Birkenhead, but that there should be a second Mersey tunnel.

The bridge has been estimated to cost £27 million, the tunnel £9 million and even with three routes over and under the river the consultants believe that saturation point will be reached within twenty years. Recalling how few months it took for saturation of the existing Mersey tunnel to build up after its opening, it is reasonable to observe that even the £36 million bridge and tunnel proposals may turn out to be adequate for a much shorter period than the years to 1980.

Two Decks

When such heavy spending is necessary to unblock even a fraction of the clogged traffic arteries it is worth looking round to find ways in which costs can be minimised and the best value for money obtained. There are two major points to be made on the bridge. The first is that of its future value in relation to the demands to be made on it.

A one deck bridge will in a certain number of years be in use to capacity and the traffic jams will accumulate at either end. But a second deck, as has been hung from the George Washington suspension bridge between New York and New Jersey, would add very substantially indeed to the number of vehicles able to cross in a given time. The George Washington bridge (ENGNG., 13 Jan., '61, pp. 50, 51), with its approaches, was built for $55 million, in 1931. Of that amount $15 million was spent on providing the means for adding to the capacity of the bridge and making the necessary additions to the approaches.

Now that the extra deck is being slung, and an extra 75 per cent added to the traffic capacity, the value of that 30 year old investment is being realised. It suggests that similar steps taken with the proposed Liverpool-Birkenhead bridge would pay off equally.

This is an economy which will only be achieved by putting out more money in the first place. A compensating saving, if not equal in amount, could perhaps be made by careful timing.

The centre span of the bridge would be 4,500 ft, making it the longest span in the world if other, longer rivals are not put up first. This centre span length is the same as that of the proposed Grimsby-Hull bridge over the Humber on the other side of Britain. In heavy engineering shops and in yards much of the work to be done for the bridges could be economically phased if the building of the Mersey and Humber bridges were to be arranged to follow a pattern of successive stages. Erection gear and experienced erectors could move on from one bridge to the next.

The interval between starting the two constructions might be 18 months or two years, and though the saving is not put forward as being one of millions, the outlay on the two schemes will plainly be extensive.

Economies do not have to be on the grand scale in order to be worth a little trouble.

and the Chemical Industry's Challenge to Engineers

The implications for the practice and standards of engineering of Imperial Chemical Industries' booklet *A High Degree of Engineering*, written by F. B. Roberts, the Editor of ENGINEERING, are profoundly important and reassuring.

It is a suspicion of people in general that individuality is stifled in the big industrial empires, and it is a fear of engineers in particular that, in the larger organisations, they will be such small units in these large teams that their creative responsibility will be but rarely exercised.

The company employs almost exactly 2,000 engineers and F. B. Roberts interviewed 200 of them. What emerges from his inquiry is a picture, not of one great regiment but of a number of platoons, in which direct responsibility comes early and where training is not continued divorced from operations.

That responsibility is given early to ICI's engineers is very clear. A senior engineer is quoted in *A High Degree of Engineering* as saying that "When an engineer is about 28 to 32 we give him a £2 million project to design." In a technically dynamic industry, the speed of change makes it something of a young man's world. One engineer said in the course of his interview: "When a man has reached a fairly senior position, say at the age of 30 . . ."

For plants with the capacity of those in the company's divisions, much of the engineering is large-scale stuff, involving the control of other engineers and courses of action which take years to bear fruit. With the policy of moving men around, widening their experience and extending their ability to solve problems, the company is shown in the pages of this booklet to be treating its staff of engineers like any other asset—caring for its maintenance and well being, enlarging its capacity and usefulness, and seeing to it that its full potential is realised.

When the firm is as big as the giant Imperial Chemical Industries organisation and its engineers so numerous, this concern for staff means that a significant proportion of the engineering profession is at work under conditions of the highest challenge.

Who's Using Unlubricated Ptfe Bearings

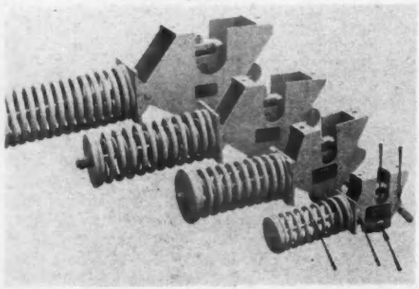
Here are a few uses of polytetrafluoroethylene (ptfe) bronze bearings. They're cheap, keep indefinitely, and are strong.

SEVERAL fit-and-forget bearing materials can now be obtained by engineers, the most familiar being oil-impregnated porous bronze. But for conditions of oscillating or sliding, and for thrust or impact-prone bearings, these are not often recommended, for it takes steady running to draw oil out of the materials to the running surface, and they are rather brittle (compared with white metal or bronze bushes).

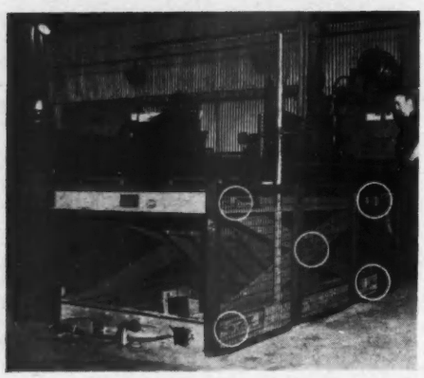
For the foregoing running conditions, and for truly "dry" applications where there must be absolutely no contamination, also where solvents in any form are present, there are several materials to choose from. Solid graphite bearings are offered by firms such as Morgan Crucible. Universal Metallic Packing Company make Deva metal which is a graphite-impregnated bronze. Polypenco offer Nylatron GS—nylon filled with molybdenum disulphide—and Fluorosint, made by the same company, is based on ptfe. Bound Brook Bearings make ptfe-impregnated "solid" bronze bushes under a process patent held by Glacier, while Glacier themselves make DU bearings and DQ machinable dry bearing material which both exploit properties of ptfe.

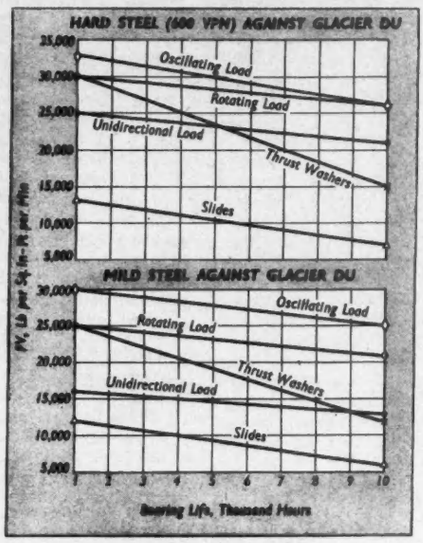
The foregoing are not the only fit-and-forget materials, and the purpose of this article is not to draw comparisons. Instead, you'll find here just a few of the uses to which one of them—Glacier DU—is being put.

DU is made from steel strip to which is sintered porous bronze impregnated with ptfe and a small amount of fine lead powder. This can be formed into bushes, washers, cups and sliders. How this is done doesn't matter. Total "coating" thickness is about 0·010 in.



***Static Load and Dirt.**—Under steady load, DU bearings will withstand up to 20,000 lb per sq. in (while with large fluctuations at high temperatures this figure is still a minimum of 2,000 lb per sq. in). Vokes Genspring find that the ability to withstand such loads, to resist dirt, and to eliminate stick-slip, make DU well suited for all bearing points in their successful pipeline supports. DU is now in standard use.*





This is, of course, without the steel backing. In calculating bearing dimensions, one can use the curves shown above, but these are not in a form usually associated with other bearing material data. Pv values are here quoted against bearing life, not wear rate. With DU, the criterion of failure is not usually a value of radial wear, but a point in time at which ptfe "lubricant" runs out—at values of radial wear well within most people's tolerances. Only when the ptfe is exhausted will the wear rate rapidly increase. Although the method of determining life is different from other bearings, the performance of DU bearings—as shown in these examples—proves that one must accept an entirely different theoretical basis for the performance of this material. In service it just means that for unattended equipment one must keep a log so that bearings are replaced before the end of their life is reached.

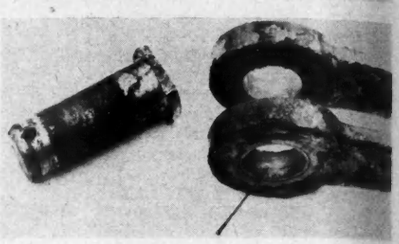
Glacier form bearings from strip, and costs are surprisingly low—a few pence for a 1 in by 1 in standard bush, for example. Bushes are light in weight yet have the strength of steel to resist pressing into housings; and unlike porous sintered materials they are not brittle. Shelf life is indefinite.

It is not advisable to broach or ream DU bearings, and this limitation must be recognised. However, accuracy is obtained by paying attention to a good standard of alignment for housing and shafts. (DQ, another grade which is not steel backed, can be machined, but it is not so strong.) Tolerances on shaft diameters are tighter than for oil-lubricated bearings because there is no gap-filling fluid; and misalignment tolerance should not exceed the recommended small value of 0·0008 in over the length of the bearing.

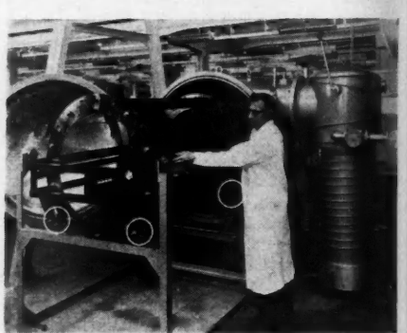
Glacier Metal Company Limited, Alperton, Middx.

***10 Tons, No Stick-Slip.**—This hydraulic lifting table will raise and lower up to 10 tons of material. It is the Bicep, made by Access Equipment, which has DU bearings at all high pressure pivots. The company find that even after periods under static load there is no stick-slip, and vertical movement can be performed smoothly at all times.*

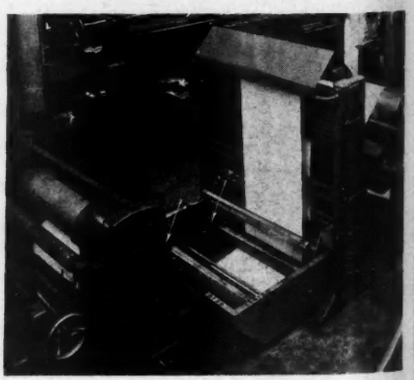
***"Lubricated" with Water.**—End bearings (ringed) for the two rollers in this dip coating machine are made from DU and work in refrigerated water. Bone Brothers, the makers, had previously encountered difficulty in maintaining conventional lubrication. DU has also been adopted as standard bearing material for other rollers to avoid contamination of paper by lubricant.*



***Reduced Maintenance.**—British Railways have tested DU in several point linkages at Euston Station which operate about 300 times a day under worse-than-normal railway conditions. After 12 months, several were stripped down and were found to be completely serviceable. Thus Glacier's estimate of 5 years' service life is likely to be attained. At the top is shown a standard lubricated assembly with ⅝ in diameter mild steel pins and hardened steel bushes after 3 months in a points mechanism. Below is a DU assembly after 9 months. This and other pins used in the other Euston tests were made from anodised aluminium which proved to be unaffected by atmospheric corrosion even though joined to cast iron.*



***Work in High Vacuum.**—Edwards High Vacuum, who make this vacuum metalliser, have categorically stated that no type of bearing other than DU has proved satisfactory for operation in this chamber. The vapour pressure of ptfe is low enough to avoid evaporation.*



Translucent Roof Lights

UAM Plastics have now standardised on two designs of dome light for long runs of top lighting for flat roofs. They are in glass reinforced polyester which is an inflammable material, but can also be obtained in a flame-retardant variety.

The insulated decking light is made in a standard size to fit a 10 ft long by 2 ft 8 in wide opening, the width having been chosen to replace two Universal asbestos cement decking units, though the lights can be used with any type of flat roof construction. The double skin insulated construction of this light has a U factor of 0·51.

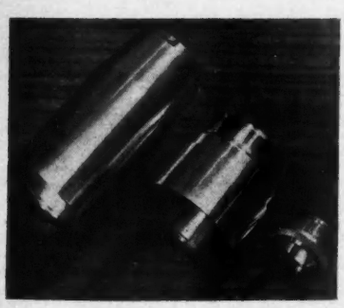
The continuous barrel light, as shown above, is made in single skin and insulated versions, in widths of 4 ft and 4 ft 5 in and in lengths up to 15 ft with both ends closed. For continuous long lengths, open ended units are available with a corrugated 5 in lap joint. Fixing is by screws to a conventional upstanding curb.

UAM Plastics Limited, Tolpits, Watford, Herts.

Free Machining Alloy Lens Mounts

Production problems in machining of photographic and television lens-mount components at the Leicester works of Taylor, Taylor and Hobson have been considerably eased by adoption of Alcan Industries' machining alloy, Noral 28S.

Machining properties of this alloy, which compare favourably with those of free-cutting brass,



are such that there is no build-up of metal on the cutting edge and no long, continuous strands of swarf. 28S is only about one-third the weight of an equivalent volume of brass and is also cheaper by nearly 50 per cent. It is normally supplied as rod or bar in sizes up to about 4 in diameter, but is also available in the form of drawn wire, tubing, and simple extruded sections.

The alloy readily accepts a corrosion-resistant anodic film, and the ability of such films to absorb coloured dyes is exploited in production of these lens mounts by using a black anodised finish as a base for the usual matt black enamel on all inner surfaces. Should the enamel get damaged in use the hard anodic coating would prevent formation of glare spots and ghost images that could otherwise occur if the bright metal surface were exposed.

Outer surfaces of many of these lens mounts, particularly those that may have to stand up to agressive conditions, are coated with a protective layer of synthetic resin lacquer. In certain cases, however, small components such as iris control rings are anodised and lacquered to give a high class satin finish.

Alcan Industries Limited, Banbury, Oxon.

Nylon Safety Straps

Following publication of a BSI specification for car safety harness there have been a number of references to the dangers of whiplash. By this is meant the violent jerking back of the body while the vehicle is still moving forward—which in extreme cases might result in a broken neck.

Extensive experimental work which has been carried out in Britain with various types of nylon harness indicates that this is a bogy which does not arise under practical conditions.

These pictures, taken on the Royal Aircraft Establishment rocket sled, show clearly what happens when a man wearing nylon safety harness is subjected to violent deceleration. Deceleration on the sled measured 11·7*g* and was probably substantially higher on the body. The top picture, taken at the moment when deceleration was at its peak shows how the subject becomes almost airborne as his body is thrown

forward against the harness. The lower picture, taken a fraction of a second later when the subject has come to rest, shows how the nylon harness has pulled him back into his seat. Note that he has not been jerked back but has simply been gently but firmly restrained. Experts believe that under crash conditions a nylon car safety harness would behave in a very similar manner.

The nylon harness which saved Donald Campbell's life, manufactured by the GQ Parachute Company, is now to be made available to private motorists in Britain. Almost identical with the standard Z type harness worn by aircrew, it complies with the extremely rigorous requirements of the Air Registration Board, the Astronautical Inspection Directorate and the Admiralty. These specifications call for harness which can withstand a loading of 25*g*. Production of this harness has already started; four other types of nylon car safety harness are under development.

A new nylon harness by Michael Richmond is intended chiefly for fleet operators and is expected to be used extensively not only in cars but also in vans and other commercial vehicles. This is a streamlined version of the BSI approved combined hip belt and shoulder strap already available to private motorists. The harness has an adjustable end-plate so that, with only two sizes, it is possible to fit almost any vehicle. The new harness is expected to be inexpensive.

Nylon car safety hardnesses are already saving drivers and their passengers from serious injury or death. A nylon lap belt made by Autosafe, one of the manufacturers approved by the BSI, saved the driver of an Austin A30 when the car skidded and crashed at 40 mph. After smashing its way through a fence, the car rolled down a 15 ft bank, turning two complete somersaults and finishing up on its wheels. The nylon belt held the driver in his seat and he escaped unharmed.

Nylon full harness made by Irving Air Chute of Great Britain saved another driver and his wife in an even more dramatic smash. The car went off the road at high speed and somersaulted, tail over bonnet, four times before coming to rest the right way up in a ditch. The driver's wife broke a finger and they both received bruises.

British Nylon Spinners, 68 Knightsbridge, London, SW1.

Cable Sheathing in Pvc/Rubber

Cables clad in a new sheathing material made from a blend of Geon pvc and Hycar nitrile rubber are now being produced by Greengate and Irwell Rubber Company. This Niplas sheathing has been used on trailing cables, welding cables and flexible power cables, such as for supplying power to the magnets of steel handling cranes.

Niplas sheathed cables, with suitable forms of insulation, are said to have shown a number of advantages over other conventionally sheathed types. The nitrile based sheathing withstands temperatures up to 85° C and has good mechanical properties, good oil, solvent and fire resistance and excellent abrasion resistance—particularly important for welding and trailing cables. Furthermore, the pvc component of the material enables Niplas sheathed cables to be manufactured in a variety of bright colours without loss of mechanical strength, and also enhances grease resistance—cables can remain smeared with

grease without deterioration.

Niplas sheathed cables have been standing up to some particularly heavy duty in the scrap metal shed of John Summers and Sons, as shown here. The sheathings had to withstand abrasion caused by considerable whipping and coiling of the cable, yet on inspection after six months' service the covering was seen to be unscathed. Although the cables frequently became coated with grease and oil, it was noted that the covering had not been attacked. The surface could be wiped clean and the colour had not changed. Electrical properties, strength and flexibility of the cables were also found to be fully satisfactory.

British Geon Limited, Devonshire House, Piccadilly, London, W1.

Plain Words

By Capricorn

THE rear lights of the car in front of me seemed to be about 50 yards away. Not that I was taking particular notice of them. My mind was on the cocktail party I had just left.

I suppose I must have had better part of half a bottle of gin—mixed with French vermouth. Right from the first drink I had been on the best possible terms with the world. No inhibitions. No awkwardness. No embarrassing silences in the conversation. Just a steady, benevolent stream of small talk with anybody and everybody—at least that is how it seemed to me. There was the fellow who knew a fellow I knew in South Wales (that coincidence launched us well into the conviviality of the evening). There was the wife who said she couldn't care less what her husband was up to. And there was the lady with whom I discussed the D'Oyly Carte Opera—only to ruin the good relations subsequently by knocking her drink over the front of her dress.

Did I say the car lights were 50 yards away? They are on top of me! I'm practically slap into the back of it. Stamp on the brakes. My friends in the car lurch forward and curse me.

I sober down. Repeat what I told myself when we left the party—be careful; you're a father, with children to think of; these friends of your's—take care of them. Be absolutely collected and sensible. Allow yourself plenty of time to think. At traffic lights. When there is oncoming traffic. When you see a road sign—even if you can't read it. Take it easy. There's no point in rushing home.

We're practically there now. Just round this corner and we're safe. Here we are. Mind the gate posts. (You have done it hundreds of times before!) Switch off. Nothing can happen now. You're actually home. We're all home!

It's all right if you take it easy. Don't try to be clever, or show off. Accept the fact that you are a bit tiddly and drive accordingly. The risk of an accident is then no higher than when you're driving sober but fast. One chance in a thousand—one in ten thousand. A motor-car is a missile, not continuously and consciously guided even when you are sober. When you are somewhat less than sober perhaps it's possible to reduce the risk by forcing yourself to drive slowly and within your capacity.

Next day I phone the hostess. Have I heard what happened after we left? No—what? Harcourt (the fellow who knew a fellow I knew in South Wales)—Harcourt had a terrible smash. He's in hospital, and his wife is too. How serious is it? We don't know yet: we're going over to the hospital this afternoon.

I expect Harcourt was like me—he probably accepted the fact that he was a bit tiddly and drove carefully.

I got away with it. Harcourt didn't.

Letters to the Editor

Civil Engineering Contracts

SIR, Referring to your Outlook 1961 article on "Civil Engineering and Building" (ENGNG., 13 Jan. '61, p. 78), the client wishing to erect a new structure has to make a choice.

Either he can employ a consulting engineer, when he will be sure of a sound design and will have a professional engineer "on his side" to supervise the work, but the work will take longer and be more expensive; or, he can put his trust in a contractor and hope that the design and construction will be satisfactory, but the works will be constructed in a much shorter time at a lower cost. Since time is usually worth money, the time saved in the latter case would generally be attractive even if the contract price were no lower.

Certain large firms enjoy the benefits of competitive design-and-construction contracts with adequate supervision and professional advice, since they are large enough to employ on their staff civil engineers who can advise management when they are first considering the project and then prepare inquiry documents, assess tenders, and supervise the works.

The tender could be issued and awarded at an earlier stage than has so far been customary and the smaller clients of the civil engineering industry could enjoy the same price and time advantages as the larger clients if consulting engineers were prepared to offer the same service to such clients as the civil engineering staff of the large companies render to their employers.

It may be that there are consulting engineers who are prepared to offer such a service to the ordinary clients of the industry but, if so, such a service is not well publicised. Since contractors', designers' and consulting engineers' staffs are interchangeable, the development of the consultant/contractor relationship on these lines would not bring about any deterioration of standards but designs would be prepared to suit the contractor's plant and methods.

No doubt certain consulting engineers would continue as specialised designers for works such as shell roofs and large dams, since the average designer/contractor would not wish to retain highly-specialised designers on his staff.

Yours faithfully,
A. P. CUMMING.

Weybridge,
Surrey.
25 January, 1961.

Metal Honeycomb Core

SIR, Metal honeycomb core is now a well-established structural material for aircraft, and your article "Commercial Honeycomb Makes Good Sense" (ENGNG., 20 Jan. '61, p. 90) is a valuable contribution towards making more widely known the advantages and potentialities of honeycomb in other industrial applications.

May we, however, be allowed to comment upon a few aspects of the subject discussed in this article?

(1) There is much to be said for the empiric, or, in your words, "try it and see" approach, but this should surely be preceded by a careful study of the design factors and types of material available. For this reason, we have published a series of metal honeycomb design and production information sheets as a basis for determining correct dimensions and production methods.

(2) The statement that "the useful strength of honeycomb is virtually that of the two skins" needs qualification. Bending, tensile and compressive loads are admittedly taken almost exclusively by the skins of the sandwich, but shear normal to the plane of the sandwich is taken almost entirely by the core.

(3) In case the impression is conveyed that metal honeycomb is most suitably employed in conjunction with aluminium skins, it may be observed that, because, for the same stiffness, steel is thinner than aluminium, there is in fact more advantage in using sandwich construction with steel than with aluminium (the core stabilises the thin material).

(4) A descriptive text referring to one of your illustrations mentions that profiling before expansion is far easier than machining already expanded honeycomb. This is true in principle, but our experience has suggested that it is usually preferable to profile in the corrugated (or after-expansion) form, because, if cutting is carried out in the unexpanded state, any irregularities of expansion will result in corresponding irregularities of profile.

The above comments are in no way intended to detract from the merit of a very informative contribution. As makers of "Aeroweb," the only aluminium honeycomb fully approved by the Ministry of Aviation for load-bearing aircraft structures, we are naturally most interested in applying the results of experience gained in the aircraft industry to the much wider subject of commercial structures in general.

Yours faithfully,
E. J. CATCHPOLE,
Manager, Bonded Structures Division.

CIBA (A.R.L.), Limited,
Duxford, Cambridge.
26 January, 1961.

Careers in Rubber

SIR, We have read with interest Mr. D. B. Welbourn's review of the *1960 Year Book of Technical Education and Careers in Industry* (ENGNG., 27 Jan. '61, p. 158).

We cannot understand Mr. Welbourn's comment about being unable to discover how to enter the rubber industry. The *Year Book* contains a section devoted to this industry and there is also an entry for the National College of Rubber Technology. If Mr. Welbourn has any suggestions for additions to the section devoted to rubber, we shall be very glad to have them.

Yours very truly,
C. W. SWINSON,
Managing Director.

A. & C. Black Limited,
London, W1.
27 January, 1961.

Events in Advance

Computers Assist the Chemical Engineer

ACCORDING to present arrangements, no fewer than seven papers are due to be discussed at the one-day symposium on "Computers for the Chemical Engineer," which is being held at Birmingham University on 28 March next.

The meeting is being organised jointly by the Graduate Section of the Birmingham University Chemical Engineering Society and the Midland Graduates and Students Section of the Institution of Chemical Engineers, and will comprise morning and afternoon sessions only. It should end around 5 p.m.

Of the three papers to be presented at the morning session, mention may be made of one entitled "Computers and Programming," by Mr. K. A. Redish, lecturer in computing at the University of Birmingham; and one on "Plant Management Applications," by Mr. D. G. Thompson, of the Esso Petroleum Company Limited, Fawley. The latter will describe the use of a digital computer for guiding management in the investment control, operations planning, and cost control of a large oil refinery.

Two of the papers to be read during the

afternoon will include one on "The Need for More Process Control Computation," by Mr. L. Gallon, of the British Petroleum Company Limited, Sunbury-on-Thames; and one on "Simple Computing Relays," by Mr. R. J. Redding and Mr. F. H. Bodley, of Evershed and Vignoles Limited, London. The latter will discuss a computing device which can add, subtract, multiply and divide. This device employs the same force balance principles as are used in the measurement transducers which normally provide its inputs.

These papers will be followed by one entitled "Anatrol: An Analogue On-Line Process Control Computer," by Mr. M. James and Mr. W. T. Lee, of the de Havilland Aircraft Company, Limited, Hatfield. This paper will provide a brief review of the current forms of process control and of the accuracy which is to be expected from measuring instruments, followed by a statement of the justification for an analogue process control computer. There will then be a description of an on-line process control computer known as the "Anatrol," which possesses certain novel principles. The remaining paper will be entitled "The Argus Digital Computer in Process Control," of which the author will be Mr. W. F. M. Payne, of Ferranti Limited, London.

It is hoped that preprints of the various papers will be available. The registration fee, covering attendance at the symposium and a copy of the full proceedings, will be £2. Application forms, summaries of the papers and other information may be obtained from the registration secretary, Chemical Engineering Department, The University, Birmingham 15. Application forms should be returned before 14 March.

Creep and Computers—Discussions in London

SIR CHARLES GOODEVE, O.B.E., F.R.S., Director of the British Iron and Steel Research Association, will take office as President of the Iron and Steel Institute at the forthcoming annual general meeting of the Institute, which is due to take place in London on 3 and 4 May next. He will deliver his presidential address on the morning of 3 May and will take the chair at the annual dinner for members, which will be held at Grosvenor House, Park Lane, London, W1, on that evening.

There will be technical sessions at the annual meeting devoted to the use of computers in the iron and steel industry and to the Brymbo oxygen steelmaking process. Certain formal business and the sessions on computers and oxygen steelmaking will take place at the Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1; the sessions on computers being held under the aegis of the British Conference on Automation and Computation.

On the same dates, 3 and 4 May, a joint symposium on structural processes in creep will take place under the joint auspices of the Iron and Steel Institute and the Institute of Metals. This function is to be held at the Hoare Memorial Hall, Church House, Great Smith Street, London, SW1. Additional particulars of these meetings may be obtained from the secretary of the Iron and Steel Institute, Mr. K. Headlam-Morley, 4 Grosvenor Gardens, London, SW1. (Telephone: SLOane 0061.)

Engineers' Contributions to Railway Modernisation

AN ACCOUNT of what has been accomplished by engineers in connection with the vast modernisation programme of British Railways will be discussed at the Railway Modernisation Conference, which is to be held at the Institution of Civil Engineers, Great George Street, London, SW1, on 3 and 4 May next.

The meeting is being organised jointly by the Institutions of Civil, of Mechanical, and of Electrical Engineers, and professional railway engineers from all parts of the world are being invited to attend.

As at present arranged, five papers will be presented. These will cover, respectively, the engineering aspects of the plan, by Mr. R. C. Bond, technical adviser to the British Transport Commission; the contribution of civil engineering by Mr. M. G. R. Smith, chief civil engineer, Western Region; the impact of mechanical engineering, by Mr. J. F. Harrison, chief mechanical engineer of the central staff of British Railways; electric traction, by S. B. Warder, chief electrical engineer of the central staff of British Railways; and signalling engineering and telecommunications, by J. F. H. Tyler, chief signal and telecommunications engineer, Southern Region.

Further particulars are obtainable from the secretaries of the Institutions of Mechanical Engineers, and of Electrical Engineers; or from the secretary, the Institution of Civil Engineers, Great George Street, London, SW1. (Telephone: WHItehall 4577.)

Agricultural Machinery on Show in Sweden

EVERY year, very considerable quantities of agricultural machinery and equipment are imported into Sweden and the total is likely to be substantially increased as a result of the lowering of trade restrictions through that country's membership of the European Free Trade Association.

Special interest, therefore, attaches to the announcement that the European Agricultural and Industrial Fair (ELMIA 61) will be held in Jönköping, in Southern Sweden, from 25 May to 4 June. The event is the first international agricultural fair of this kind to take place in Sweden.

In addition to agriculture in its various fields, there will be sections devoted to domestic equipment, handicrafts and hobbies, and it is understood that a number of sites have already been reserved by manufacturers, in these sectors of industry, in countries abroad as well as in Sweden. Additional information regarding the exhibition may be obtained from the United Kingdom agents: Empson and Turner Limited Thorn House, Upper St. Martin's Lane, London, WC2, or by telephoning TEMple Bar 9081.

Exhibitions and Conferences

Iron and Steel Institute, Annual General Meeting.—Wed. and Thurs., 3 and 4 May, at the Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. Will include sessions on computers (under aegis of the British Conference on Automation and Computation) and on oxygen steelmaking. Institute's offices: 4 Grosvenor Gardens, London, SW1. Tel. SLOane 0061.

Ontario Medical Association's Annual Convention and Exhibition, 81st.—Mon., 8 May, to Fri., 12 May, at the Royal York Hotel, Toronto. Including medical appliances and equipment. Organised by the Ontario Medical Association, 244 St. George Street, Toronto, Canada.

West Coast Castings Congress and Foundry Exposition.—Mon., 8 May, to Fri., 12 May, at Exhibition Hall, Civic Center, San Francisco, USA. Organised by the American Foundrymen's Society, Golf and Wolf Roads, Des Plaines, Illinois, USA.

Higher Management, Course for.—Mon., 8 May, to Fri., 19 May; and Mon., 29 May, to Fri., 2 June, at Dunford College, near Midhurst, Sussex. Inquiries should be made to offices of Associated Industrial Consultants Ltd., or to AIC College of Management, 54-58 Uxbridge Road, London, W8. Tel. EALing 4567.

MESUCORA: Exposition Internationale, Mesure, Controle, Régulation, Automatisme (58th Exhibition of the Société Française de Physique).—Tues., 9 May, to Wed., 17 May, at the Centre National des Industries et des Techniques, Paris. Offices: 20 Rue Carpeaux, Puteaux, Seine, France.

Communications Satellites, Symposium on.—Fri., 12 May (10 a.m. to 5 p.m.), at the Federation of British Industries, 21 Tothill Street, London, SW1. Organised by the British Interplanetary Society, 12 Bessborough Gardens, London, SW1. Tel. TATe Gallery 9371.

Stationery Show.—Sun., 14 May, to Fri., 19 May, at the Hotel New Yorker, New York. Organised by Little Brothers Shows, Inc., 220 Fifth Avenue, New York, USA.

Self-Service and Shop Equipment Exhibition.—Mon., 15 May, to Fri., 19 May, at Olympia, London, W14. Organised by Universal Exhibitions Ltd., 74 Holland Park, London, W11. Tel. PARk 7723.

Automatic Vending Exhibition, Third International.—Mon., 15 May, to Fri., 19 May, at the Royal Horticultural Society's New Hall, Greycoat Street, London, SW1. Sponsored by the Automatic Vending Machine Association, 51 Lincoln's Inn Fields, London, WC2. Organised by Contemporary Exhibitions Ltd., 2 Dunraven Street, Park Lane, London, W1. Tel. HYDe Park 5421.

Waste Heat Recovery from Industrial Furnaces, Conference.—Mon., 15 May, to Fri., 19 May, at Bournemouth. Coinciding with the conference will be an exhibition of plant and equipment illustrating the recovery of waste heat. Applications should be made to the secretary, Institute of Fuel, 18 Devonshire Street, Portland Place, London, W1. Tel. LANgham 7124.

Hospital Equipment and Medical Services Exhibition, Third International.—Mon., 15 May, to Sat., 20 May, at Olympia, London, W14. Organised by Contemporary Exhibitions Ltd., 2 Dunraven Street, Park Lane, London, W1. Tel. HYDe Park 5421.

Nuclear Electronics, Conference.—Mon., 15 May, to Sat., 20 May, in Belgrade. Apply to the International Atomic Energy Agency, Kaerntnerring, Vienna 1, Austria.

Television Equipment Trade Fair, First International.—Mon., 15 May, to Sat., 27 May, at Montreux. Organised by the World's First International Festival of Television Arts and Sciences, 8 Grand-Rue, Montreux.

British Sole Leather Fair, Third.—Tues., 16 May, to Thurs., 18 May, at St. Ermin's Hotel, Caxton Street, London, SW1. Including leather-preparing machinery. Organised by the United Tanners' Federation, Leather Trade House, 17-19 Barter Street, London, WC1. Tel. HOLborn 9784.

British Upper Leather Fair, Fourth.—Tues., 16 May, to Thurs., 18 May, at St. Ermin's Hotel, Caxton Street, London, SW1. Including leather-preparing machinery. Organised by the United Tanners' Federation, Leather Trade House, 17-19 Barter Street, London, WC1. Tel. HOLborn 9784.

Footwear Components Exhibition, Third.—Tues., 16 May, to Thurs., 18 May, at the Washington Hotel, Curzon Street, London, W4. Open to the trade only. Organised by the Exhibition Department, *Footwear*, Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

Engine Testing of Crankcase Lubricating Oils, International Symposium.—Wed., 17 May, to Fri., 19 May, at Brighton. Organised by the Engine Tests of Lubricants Panel of the Institute of Petroleum. Offices of the Institute: 61 New Cavendish Street, London, W1. Tel. LANgham 3583.

Paris International Trade Fair, 51st.—Thurs., 18 May, to Mon., 29 May, in Paris. In the United Kingdom, applications should be made to the French Chamber of Commerce, 74 Brook Street, London, W1. Tel. HYDe Park, 2744.

Budapest Industrial Fair.—Fri., 19 May, to Mon., 29 May, in Budapest. Organised by the Hungarian Chamber of Commerce, 17 Rosenberg h.p.n., Budapest V, Hungary.

British Trade Fair in Moscow.—Fri., 19 May, to Sun., 4 June, at Sokolniki Park, Moscow. Open to trade and public. British capital and consumer goods. Organised by Industrial and Trade Fairs Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

Ontario Dental Association's Annual Convention and Exhibition, 94th.—Sun., 21 May, to Wed., 24 May, at the Royal York Hotel, Toronto. Including dental appliances and equipment. Organised by the Ontario Dental Association, 230 St. George Street, Toronto 5, Ontario, Canada.

Restaurant Association (National), 42nd Annual Convention and Exposition.—Mon., 22 May, to Thurs., 25 May, at McCormick Place, Chicago. Organised by the National Restaurant Association, 1530 North Lake Shore, Chicago 10, Illinois, USA.

Tool and Manufacturing Engineers' Annual Show and Convention.—Mon., 22 May, to Fri., 26 May, at the Coliseum, New York. Organised by the American Society of Tool and Manufacturing Engineers, 10700 Puritan Avenue, Detroit 38, Michigan, USA.

Drawing Office Equipment and Materials, First National Exhibition.—Mon., 5 June, to Thurs., 8 June, in the Royal Horticultural Society's New

Hall, Greycoat Street, London, SW1. Organisers: UTP Exhibitions Ltd., 9 Gough Square, Fleet Street, London, EC4. Tel. FLEet Street 3172.

Effects of Radiation on Nerves and the Central Nervous System, Symposium.—Mon., 5 June, to Fri., 9 June, 1961, in Vienna. Apply to the International Atomic Energy Agency, Kaerntnerring, Vienna 1, Austria.

Suppliers for Furniture, Upholstery and the Wood Processing Industries, International Fair of (INTERZUM).—Thurs., 8 June, to Sun., 11 June, 1961, in Cologne. Inquiries in the United Kingdom should be sent to Mr. Neven du Mont, 123 Pall Mall, London, SW1. Tel. WHItehall 8211.

Chemical Engineering, European Congress, comprising the **1961 ACHEMA Congress;** the **13th Exhibition and Congress of Chemical Engineering** organised by DECHEMA; special meeting of the **Gesellschaft Deutscher Chemiker;** annual meeting of the **DECHEMA Deutsche Gesellschaft für Chemisches Apparatewesen;** annual meeting of the **Isotopen, Studiengesellschaft;** and a symposium on "The Physical and Chemical Durability of Structural Materials in the Chemical Industry," being the **15th meeting of the European Federation of Corrosion.**—Fri., 9 June, to Sat., 17 June, 1961, at Frankfurt on Main. Apply to DECHEMA 25 Rheingau-Alaa, Frankfurt on Main, Germany.

Poznan International Fair, 30th.—Sun., 11 June, to Sun., 25 June, 1961, in Poznan. Official forwarding agents: P.S.A. Transport Ltd., 70 Old Broad Street, London, EC4. Tel. AVEnue 2424.

Bordeaux International Trade Fair, 40th.—Sun., 11 June, to Mon., 26 June, 1961, in Bordeaux. Agents: Auger and Turner Group Ltd., Thorn House, Upper St. Martin's Lane, London, WC2. Tel. TEMple Bar 9081.

British Electrical Power Convention.—Mon., 12 June, to Thurs., 15 June, 1961, at Eastbourne. Theme: "Electricity in the Prosperity and Welfare of the Nation." Offices of the convention: Winsley Street, London, W1. Tel. MUSeum 4040.

Technical Writers' Institute, Ninth Annual.—Mon., 12 June, to Fri., 16 June, 1961, at Rensselaer Polytechnic Institute, Troy, NY, USA. Theme: "The Technical Writer and His Relation to the Expanding Uses of Communications in Modern Industry and Government." Apply to Professor Jay R. Gould, Rensselaer Polytechnic Institute, Troy, NY, USA.

Meetings and Papers

Aslib

LONDON
"Royal Aeronautical Society's New Lecture Hall," by Anthony J. Barrett. At the Royal Aeronautical Society, 4 Hamilton Place, W1. Wed., 22 Feb., 6 p.m.*

British Institution of Radio Engineers

LONDON
"Transistorised Medical and Biological Electronic Equipment": Discussion. Medical Electronics Group. London School of Hygiene and Tropical Medicine, Keppel Street, W1. Wed., 22 Feb., 5.30 p.m.*

CHELTENHAM
"Design Aspects and Characteristics of Long-Distance Waveguide Communication Systems," by Dr. A. E. Karbowiak. South Midlands Section. North Gloucestershire Technical College, Cheltenham. Fri., 24 Feb., 7 p.m.

SOUTHAMPTON
"Application of Computers to Commercial Problems," by N. D. Hill. Southern Section. Lanchester Building, The University, Southampton. Wed., 22 Feb., 7 p.m.

Chemical Society

BELFAST
"Principles of Radiation Chemistry and the Possibilities of Its Industrial Application," by Professor F. S. Dainton. Northern Ireland Branch. Chemistry Department, Queen's University, Belfast. Thurs., 23 Feb., 7.45 p.m.

Illuminating Engineering Society

LEICESTER
"Basis of Recommended Illumination Levels in Britain and the United States," by A. W. Marsden. Leicester Centre. East Midlands Electricity Board, Charles Street, Leicester. Thurs., 23 Feb., 6.15 p.m.

Institute of Metals

LONDON
"The Theory of the Alloys of Copper," by Professor W. Hume-Rothery. Royal Institution, Albemarle Street, W1. Thurs., 23 Feb., 6.30 p.m.

Institute of Road Transport Engineers

ACCRINGTON
"Recent Developments in Automotive Diesel Engines": Discussion. Northern Centre. Commercial Hotel, Accrington. Thurs., 23 Feb., 7.30 p.m.

DURHAM
"Diesel Power Units," by D. Kaberry. North Eastern Centre. Three Tuns Hotel, Durham City. Tues., 21 Feb., 7 p.m.

Institution of Chemical Engineers

MANCHESTER
"Floating Cap Trays for Absorption and Distillation," by W. S. Norman. North Western Branch. Manchester College of Science and Technology, Jackson Street, Manchester 1. Tues., 21 Feb., 6.30 p.m.

Institution of Civil Engineers

LONDON
"Elastic Theory and Engineering Structures," by Professor A. J. S. Pippard. James Forrest Lecture. Tues., 21 Feb., 5.30 p.m.*

Institution of Electrical Engineers

LONDON
"Sphere-Gaps," by Dr. E. Kuffel: supported by a series of papers by the same author. Joint meeting of the Measurement, Supply and Utilization Sections. Tues., 21 Feb., 5.30 p.m.*
"Coding Theory and Its Applications," by Dr. J. M. Meggitt. Electronics and Communications Section. Wed., 22 Feb., 5.30 p.m.*

CHESTER
"Application of Electronics to the Electricity Supply Industry," by Dr. J. S. Forrest. Third Hunter Memorial Lecture. Joint meeting of the North Western Centre and the Mersey and North Wales Centre. Town Hall, Chester. Mon., 20 Feb., 6.30 p.m.

EDINBURGH
"British Nuclear Power Today," by A. L. Shaw. South East Scotland Subcentre. Carlton Hotel, Edinburgh. Tues., 21 Feb., 7 p.m.

GLASGOW
"Radiocommunication in the Power Industry," by E. H. Cox and R. E. Martin. South West Scotland Subcentre. 39 Elmbank Crescent, Glasgow, C2. Wed., 22 Feb., 6 p.m.

NOTTINGHAM
"Design of a Defensive Guided Missile," by J. A. Robinson. Portland Building, The University, Nottingham. Thurs., 23 Feb., 6.30 p.m.

SOUTHAMPTON
"Aircraft Electrical Power Systems," by H. Zeffert and J. P. Ratcliffe. Southern Centre. The University, Southampton. Wed., 22 Feb., 7 p.m.

Institution of Engineers-in-Charge

LONDON
"Recent Developments in Industrial Lighting Practice," by G. B. Durham. British Lighting Council, Brettenham House, 16-18 Lancaster Place, WC2. Wed., 22 Feb., 6.30 p.m.*

Institution of Heating and Ventilating Engineers

GLASGOW
"Sound Control in Ventilating Systems," by E. G. Ewing. Scottish Branch. Scottish Building Centre, 425 Sauchiehall Street, Glasgow, C2. Tues., 28 Feb., 7 p.m.

Institution of Locomotive Engineers

LONDON
"Collection and Assessment of Technical Information, Including the Language Problem," by B. R. Byrne and Joan Ritchie. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Tues., 21 Feb., 5.30 p.m.*

Institution of Mechanical Engineers

LONDON
"Influence of Availability of Enrichment on Reactor Type and Design": Discussion, to be opened by E. Norton. Nuclear Energy Group. Mon., 20 Feb., 6 p.m.*
"Controlled Fusion Reactions," by Professor P. M. S. Blackett. Thomas Hawksley Lecture. Wed., 22 Feb., 6 p.m.*

BELFAST
"Production of Iron and Non-Ferrous Castings for the Heavy Engineering Industry," by E. Nelson. Northern Ireland Branch. Joint meeting with the local Graduate Section. Kensington Hotel, Belfast. Thurs., 23 Feb., 6.45 p.m.

BRIGHTON
"Teaching Metallurgy to Engineers," by Professor J. C. Ball. Southern Branch. Technical College, Brighton. Thurs., 23 Feb., 7.30 p.m.

NOTTINGHAM
"Design of a Defensive Guided Missile," by J. A. Robinson. East Midlands Branch. Portland Building, The University, Nottingham. Thurs., 23 Feb., 6.30 p.m.

SWANSEA
"Early Development of the Dracone Flexible Barge," by Professor W. P. Hawthorne. Thomas Lowe Gray Lecture. South Wales Branch, Offices of the South Wales Electricity Board, Kingsway, Swansea. Tues., 21 Feb., 6 p.m.

Institution of Plant Engineers

SHEFFIELD
Discussion of case studies. Annual General Meeting. Sheffield Branch. Grand Hotel, Sheffield. Thurs., 23 Feb., 7.30 p.m.

Institution of Production Engineers

HUDDERSFIELD
"Lubrication Problems on Machine Tools," by G. M. Brown, at 7.30 p.m. (Annual Meeting at 7 p.m.) Halifax and Huddersfield Section. Engineering Tower, Technical College, Huddersfield. Tues., 21 Feb.

NEWCASTLE UPON TYNE
"Design of Bluebird," by Donald Stevens. Newcastle upon Tyne Section. Connaught Hall, Blackett Street, Newcastle upon Tyne. Mon., 20 Feb., 7 p.m.

SHREWSBURY
"Production Planning and Control by Computer": Discussion. Shrewsbury Section. New Technical College, London Road, Shrewsbury. Wed., 22 Feb., 7.30 p.m.

Institution of Structural Engineers

BIRMINGHAM
"Computers and Structural Design: Present Position and Future Trends," by R. E. Rowe. Midland Counties Branch. College of Advanced Technology, Gosta Green, Birmingham 6. Fri., 24 Feb., 6.30 p.m.

CARDIFF
"Economics of Framed Structures," by L. R. Creasy. Wales and Monmouthshire Branch. South Wales Institute of Engineers, Park Place, Cardiff. Tues., 21 Feb., 6.30 p.m.

Junior Institution of Engineers

LONDON
"Traffic Engineering in Urban Areas," by J. T. Duff. Fri., 24 Feb., 7. p.m*

Manchester Metallurgical Society

MANCHESTER
"Metallurgical Applications of Radioisotopes," by Dr. M. C. Inman. Manchester Literary and Philosophical Society, George Street, Manchester. Wed., 22 Feb., 6.30 p.m.

North East Coast Institution of Engineers and Shipbuilders

NEWCASTLE UPON TYNE
"Marine Steam Turbine Design and Operation," by A. F. Veitch. Neville Hall, Westgate Road, Newcastle upon Tyne. Fri., 24 Feb., 6.15 p.m.

Reinforced Concrete Association

BRISTOL
"Model Analysis of Structures," by R. E. Rowe. West of England Branch. New School of Engineering, The University, Bristol. Thurs., 23 Feb., 6 p.m.*

Royal Aeronautical Society

LONDON
"Newer Metallic Materials of Construction," by Dr. N. P. Inglis. Tues., 21 Feb., 7 p.m.

Royal Institution

LONDON
"Radio Astronomy and Cosmology," by Professor Martin Ryle. Fri., 24 Feb., 9 p.m.

Royal Society

LONDON
"Some Recent Developments at the National Physical Laboratory," by Sir Gordon Sutherland. Thurs., 23 Feb., 4.30 p.m.*

Royal Society of Arts

LONDON
"Geography and the Business World of Today," by Lord Nathan. Wed., 22 Feb., 6 p.m.

Royal United Service Institution

LONDON
"Economics of Technical Defences," by Graham Hutton. Wed., 22 Feb., 3 p.m.

Sheffield Metallurgical Association

SHEFFIELD
"Some Aspects of Basic Refractories," by J. Owen. BISRA Laboratories, Hoyle Street, Sheffield. Tues., 21 Feb., 7.30 p.m.

Society of Instrument Technology

GLASGOW
"Interesting the Instrument Mechanic in Fundamental Principles," by F. Rout. Scottish Section. Building Centre, 425 Sauchiehall Street, Glasgow, C2. Fri., 24 Feb., 7.15 p.m.

MIDDLESBROUGH
"New Steel-Making Processes and Their Control Problems," by Dr. P. A. Young. Tees-Side Section. Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough. Wed., 22 Feb., 7.30 p.m.

NEWCASTLE UPON TYNE
"Education and Training of Instrument Artificers," by B. W. Ramsay. Newcastle Section. Roadway House, Oxford Street, Newcastle upon Tyne 1. Wed., 15 Feb., 7 p.m.

NEWPORT
"Manufacture, Properties and General Uses of Metal Bellows," by R. W. Houghton. South Wales Section. Newport and Monmouthshire College of Technology, Newport. Wed., 22 Feb., 6.45 p.m.

WIRRAL
"The Atomic Clock," by J. V. L. Parry. Chester Section. Administration Building, Associated Ethyl Co., Ltd., Oil Sites Road, Ellesmere Port, Wirral. Thursday, 23 Feb., 7 p.m.

Television Society

LONDON
"Programme Problems and Possibilities Associated with 'Monitor,'" by Huw Wheldon. Cinematographers' Association, 164 Shaftesbury Avenue, WC2. Thurs., 23 Feb., 7 p.m.

West of England Metallurgical Society

BRISTOL
"Metallurgy in Modern Jewellery," by Miss Dorothy Pile. College of Technology, Ashley Down, Bristol 7. Tues., 21 Feb., 7.30 p.m.

West of Scotland Iron and Steel Institute

GLASGOW
"Layout and Design of a Hot-Strip Mill," by M. F. Dowding, C. Sturdy and A. A. Thomas. Joint meeting with the Engineers' Group of the Iron and Steel Institute. Fri., 24 Feb., 6.45 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

Aslib (Association of Special Libraries and Information Bureaux), 3 Belgrave Square, London, SW1. (BELgravia 5050)
British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
Chemical Society, Burlington House, Piccadilly, London, W1. (REGent 0675)
Illuminating Engineering Society, 32 Victoria Street, London, SW1. (ABBey 5215)
Institute of Metals, 17 Belgrave Square, London, SW1. (BELgravia 3291)
Institute of Road Transport Engineers, 69 Victoria Street, London, SW1. (ABBey 6248)
Institution of Chemical Engineers, 16 Belgrave Square, London, SW1. (BELgravia 3647)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Engineers-in-Charge, 13 Grange Close, Edgware, Middlesex. (MILl Hill 3543)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Locomotive Engineers, 28 Victoria Street, London, SW1. (ABBey 6672)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Institution of Production Engineers, 10 Chesterfield Street, London, W1. (GROsvenor 5254)
Institution of Structural Engineers, 11 Upper Belgrave Street, London, SW1. (SLOane 7128)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London, SW1. (VICtoria 0786)
Mancester Metallurgical Society, The Kennedy Press, Ltd., 31 King Street West, Manchester 3.
North East Coast Institution of Engineers and Shipbuilders, Bolbec Hall, Newcastle upon Tyne 1. (Newcastle 20289)
Reinforced Concrete Association, 94-98 Petty France, London, SW1. (ABBey 4505)
Royal Aeronautical Society, 4 Hamilton Place, London, W1. (GROsvenor 3515)
Royal Institution, 21 Albemarle Street, London, W1. (HYDe Park 0669)
Royal Society, Burlington House, Piccadilly, London, W1. (REGent 3335)
Royal Society of Arts, John Adam Street, Adelphi, London, WC2. (TRAfalgar 2366)
Royal United Service Institution, Whitehall, London, SW1. (WHItehall 5854)
Sheffield Metallurgical Association, 64 Crescent Road, Sheffield 7. (Sheffield 52865)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)
Television Society, 166 Shaftesbury Avenue, London, WC2. (TEMple Bar 3330)
West of England Metallurgical Society. Apply to Mr. P. C. Thornton, College of Technology, Bristol.
West of Scotland Iron and Steel Institute, 39 Elmbank Crescent, Glasgow, C2. Central 5181)

How Hasty Innovation Caused Disaster

The case of Pakitt Limited, where changes in working methods were introduced too rapidly, were inadequately understood by men and management, and led to a breakdown in relationships.

By Austen Albu, M.P., A.M.I.Mech.E., M.I.Prod.E.

INDUSTRIAL consultants have to sell their services. In some cases their anxiety to do so can lead to misunderstanding by the client of what he is buying and inadequate study by the consultants of the situation in which they will be required to work. Overselling is a fault of which industrial consultants may be guilty as much as anybody else.

These seem to be the main conclusions of a recent case-study report, *The Human Implications of Work Study, the Case of Pakitt Ltd.* The report was prepared by Stuart Dalziel and Lisl Klein of the Human Sciences Unit, Warren Springs Laboratory, Stevenage.

This account is not a sophisticated scientific study of the attitudes of the people involved in the application of a new technique, but a useful description by participating observers of the steps which led eventually to failure.

The company concerned is a Midlands firm of carton manufacturers employing just under 400 employees. It is a family business with a reputation for progressive ideas in a highly competitive industry. The production staff is responsible to the works managing director, who is a woman and, as it appears from the report, a considerable personality.

The firm's interest in work study originated in a desire to improve control by a system of cost accounting. In 1955 they asked for help from a well known firm of consultants, who allotted a senior staff member to the job. He made a three-day survey on the basis of which a work study application was proposed in one of the finishing departments. This study was to take 20 weeks and was estimated to show substantial savings.

It was here that the first mistake was made, for the firm had a completely different idea of the meaning of work study from the consultants. For the firm, one of whose engineers had attended a work study course and was eventually put in charge of the firm's own department, the main emphasis was on method study. The consultants, however, had a much narrower approach and, although they made a number of suggestions for minor changes in methods of working, they were mainly concerned with work measurement. They were thus more interested in establishing tables of synthetic values for the time elements of the jobs studied and the introduction of an incentive bonus system based on standard times.

CROSS PURPOSES ON WORK STUDY

In practice, the attempt to establish synthetics failed for a number of reasons which should obviously have been considered before an attempt was made to introduce any more rigid system of control.

The job, which consisted of "stripping" or breaking-up cartons which had been printed and cut out on flat board, involved a degree of manual dexterity which it took three or four months to acquire. To meet fluctuations in the load on the section, the number of people who worked on stripping varied greatly from time to time. There was considerable variation not only in the work, but also in the quality of the basic material due to variations in board thickness, cutting and creasing, and humidity conditions.

The established practice had been for piece-work prices to be set by the works managing director, based on her examination of the sheet, and on already established rates for similar work. This provided a considerable degree of flexibility, and if it led to the existence of "good" and "bad" rates for the job, the workers accepted this shortcoming because it left them a margin of manoeuvre within which they could maintain their total output and level of earnings. In particular, they had some freedom of choice because they collected their own work, whereas the consultsnts introduced a load-mover so that strippers should not lose time fetching loads.

TOO LITTLE TIME

It would seem that the promise made by the consultants to effect savings within 20 weeks left them insufficient time to make a complete study of all the factors—technical, organisational and human—involved, with the result that breakdown occurred.

The report makes it clear that there was no initial opposition from the workers or their trade union, which was not hostile to work study. On the other hand it is also clear that the workers, as well as the management, did not understand what it was that the consultants proposed to do.

In interviews with the research workers, it was disclosed that, though the proposals had been agreed at works meetings, there were differing views as to what had taken place. What happened, as is so often the case, was that the workers were faced with a brand new proposition which had already been the subject of lengthy discussion between the works managing director and the consultants and it is not surprising if the majority of them did not understand what it was that they were supposed to have agreed to. Most of them thought vaguely in terms of improvement in methods, followed by piece rates on which they were reassured by the consultants they would not lose.

This is a situation easily envisaged by anyone who has ever been involved in trying to get a change accepted by a working group. No doubt the consultants, in their anxiety to get their proposal accepted, blurred over the fact that time study was its main element; but it is extraordinary that the firm's management never realised this. Once the consultants started work, difficulties began to arise, and, as they had to show results before they left, the pressure to apply the new system grew.

In order to be able to judge the savings made, it was agreed that, before the consultants began the application of their system, an analysis should be made of production in the section for a typical period and, by applying the synthetics to the work produced, an estimate could be made of the labour cost under the new scheme compared with that under the old method. A work specification was also to be made describing the operations studied, the methods to be used, the basis on which work values were to be established and the detailed working of the bonus scheme.

Difficulties arose in selecting a typical test period, which had not been foreseen by the consultants, and in the need to exclude temporary workers in the analysis of wages. These, and other difficulties, led to delays and to arguments over the interpretation of results.

The effects of all these difficulties and misunderstandings led to lack of confidence on the part of the firm and a worsening relationship between the consultants and both the management and the workers.

Operatives felt that they were working under much greater constraint, but were unable to earn any more, and there were unrecognised changes in the functions and position of the supervisor concerned, which seriously affected his control over his section and subjected him to considerable strain.

In this situation there was an increasing amount of talk between consultants and strippers, between management and consultants, between management and strippers and, as a result, delays occurred in returning bonus cards to strippers and in dealing with queries. Strippers began to leave and finally the decision was made to withdraw work study from the section.

This is a sad story. How typical is it? This is difficult to judge because, although there are many reports of successful applications of work study, the failures naturally are not advertised.

Obviously a consultant has advantages and disadvantages in introducing a new technique into an unknown firm. On the one hand he brings, if he is qualified, experience from a number of other applications. On the other hand he may, as in this instance, have no knowledge of the industry involved and he may have insufficient time to understand the human relationships and the traditions of working behaviour in the firm.

The very speed at which he offers to introduce the change mitigates against its acceptance in face of the inevitable resistance of people to alterations in the existing practice by which they work. As change is introduced the unavoidable discomforts which it causes before its full results can be achieved lead to impatient criticism.

Perhaps only where a substantial increase in earnings is the first obvious result can such crude methods as the introduction of incentive payments based on time study by themselves be accepted by workers. And only where control has been so weak that *any* system must reduce costs, will management immediately feel that the changes have been worthwhile.

TAKE ACCOUNT OF PEOPLE

In this case both the workers and the management were promised financial benefits and their failure to materialise led inevitably to recrimination. One cannot help comparing the ethics of the promises made on this occasion with the ethical standing of a doctor or psychiatrist who promises to cure his patients, and within a specified time. Here too, the practitioner is dealing with that most intractable machine, the human being.

It appears that the firm obviously expected a more sophisticated approach by the consultants. Time study, as several research analyses have shown, is a highly unscientific activity. By itself it is probably little better in fixing incentive times than an agreed bargain struck between skilled workers and experienced management between whom a degree of confidence exists.

A system which, in an attempt to appear scientific, breaks up a job into its elements and removes from the worker those ancillary activities, such as load fetching, which help to break the monotony of his routine, and which withdraws from the supervisor discretionary power, may seem to aggravate those feelings of pressure, loss of freedom and delay which were expressed by the workers in this case. Very many industrial jobs provide little inherent satisfaction and are unbearable unless they leave some degree of freedom and power of decision to the worker. This frustration may well be the cause of short-term wild-cat strikes.

Perhaps nothing is of greater importance in British industry at the present time than the encouragement of innovation. Changes in products, in methods of manufacture, in management organisation, in selection and training are urgently needed in many industries. They will not be achieved unless their psychological and sociological effects are carefully considered and taken into account at the time they are planned.

Studies such as this make a useful contribution to our understanding of management problems and both the management of the firm and the consultants are to be congratulated on allowing it to be made and the results to be published.

Occupational Dermatitis and Cutting Oils

There are controversial issues in pre-employment medical grading and in the use of production oils in relation to skin diseases. Care given to the good storage of cutting fluids may lead the operator to better care in personal habits.

A CONSIDERABLE amount of literature has previously been devoted to the problem of occupational dermatitis and it is, of course, a matter of importance to companies and workers concerned with materials which may be thought to promote skin irritation. The measures used over the years to combat this hazard have been subject to a certain change of fashion and the awareness of operators is, from time to time, influenced by published material and by word of mouth.

One authority has stated that 70 per cent of all time lost in engineering factories is due to skin irritation troubles, but experience suggests that this tends to overrate the seriousness of the trouble. The majority of time lost is due to normal seasonal disturbances completely unassociated with the worker's occupation. But, of the time lost through occupational hazards, perhaps 50 per cent is due to skin irritation and associated problems. Statistics for the number of reportable cases which occur in the engineering industry, are hard to come by.

Data published for the USA, where there are over half a million people registered as machinists, show that in one year 41,000 skin irritation cases were reported in all states. 18 per cent were due to contact with a material containing a petroleum product in one form or another. Of this number, only a small percentage could have been considered as resulting from contact with production oils but there is no information on what this proportion is likely to be. If we suppose that as many as 50 per cent of all the contacts with petroleum products were, in fact, contacts with production oils, it would indicate that in the USA the incidence of skin irritation complaints among machinists in any one year will be rather less than 1 per cent of the total employed. This is by no means insignificant but it does serve to show that the problem is basically not a major one.

SUSCEPTIBILITY TO IRRITATION

Young people who are new to a particular trade may be susceptible to skin irritations of the "flare-up" type purely because they have not been able to become adjusted to the environment; on the other hand, older people, in whom skin changes are beginning to occur, will also be susceptible to quite intense skin irritation.

This raises the important question as to whether industry should exercise discretion in job allocation on an age basis and by pre-employment medical inspection.

The tendency for some people to develop intense involuntary skin eruptions in the presence of specific chemicals (these are sometimes known as allergies) has been somewhat overrated, but is nevertheless, a factor which cannot be ignored. Industrial employers are somewhat in a cleft stick with regard to those operators who may be allergic to specific chemicals; it has been considered by some medical authorities that the pre-employment patch tests on the skin might enable them to eliminate reactive people but it involves the difficulty that the individual might claim in the event of a positive reaction and the company might be obliged to compensate him for having induced the adverse result. Another objection is that a positive patch test only indicates an allergic sensitivity which has already been acquired. It does not indicate a general propensity of the individual to acquire other sensitivities in the future.

In all skin afflictions which are occupational, industry is faced with the problem that so long as the person is at work when the skin affliction arises it will be regarded as being occupational, thus imposing a very great difficulty for the works doctor, not only in diagnosing those afflictions which are the direct result of an occupational hazard but in putting over the point of view to the patient.

Of the materials used in engineering production workshops, the soluble oils are, if anything, less offensive than neat oils but, in any event, the type of irritation produced by the two classes of production oils will be slightly different.

Two skin effects are recognisable: the first is oil acne, due to irritation (simple blocking is not enough) of the hair follicles and leading to blackheads, folliculitis (nothing to do with infection, even though pus is present) and granulomata. The type of lesion present depends on the degree and depth of irritation. The second is dermatitis, an inflammation of the surface of the skin in which de-fatting, maceration, alkalinity, abrasive action and a number of other unknown factors, including allergy, all play a part, though no doubt in varying proportions from case to case and oil to oil.

Infection is of no importance except as a very uncommon secondary complication.

It has been suggested that some skin complaints may arise from bacterial infection of wounds or small penetrations of the skin. Many investigations have been made to determine the type and distribution of bacteria in production oils. Most investigators are agreed that very few bacteria are found in the straight cutting oils when delivered from the manufacturer. There is no tendency, therefore, for them to increase in number when the oil is in service, unless the oil becomes contaminated from contact with an infected operator, in which case the oil may merely act as a means of transposing harmful organisms from one site to another. It does not usually act as a growth medium.

Soluble oils on the other hand, since they contain a high proportion of water, are well capable of acting as a breeding ground for a very wide variety of organisms. The basic soluble oil will usually show very low bacteria counts on delivery from a supplier, but when made up in emulsion form bacteria counts will increase quite rapidly with service, according to the oil type and the emulsion strength.

One American case has been reported of a soluble oil which had been in service for nine months without replenishment or reconditioning in any way. It was extremely dirty and had a high bacteria count even when diluted by 1,000, yet no case of skin irritation occurred on that plant while the oil was in service.

This seems to support the contemporary opinion among British and American dermatologists that infection and bacteria play no part in the causation of industrial dermatitis.

The preceding remarks pose the problem whether the incorporation of bactericides into soluble oils is justified. Nevertheless, the phenolic coupling agents, used by many manufacturers to fulfil an essential function in providing stability of the emulsion, can also provide antiseptic properties which could be of some benefit in keeping bacteria growth to a minimum. Bactericides specifically developed for use in soluble oil manufacture are, at the present time, of such high price that the cost of using them at a panacidal concentration is prohibitive. The use of smaller concentrations than the panacidal dose may give temporary relief but may, in fact, eventually lead to the development of resistant strains and the final stage may, therefore, be worse than the initial. It is important here to note that many so called lubricant "bactericides" are bacteriostatic in action, that is, under certain conditions the bacteria can be revived and become active again. Many phenolic compounds act as genuine bactericides in that organisms treated with them are not revivable with any known material. The phenolic compounds added to cutting oils do not constitute any real hazard with regard to the causation of dermatitis. These are present in concentrations too low to have any irritant action. Those used in soluble oils as couplers might conceivably cause some irritation, but in practice rarely appear to do so.

Medically speaking then, the use of bactericides is probably not justified. On the other hand, some bactericides do have value in controlling bacterial attack on the emulsion itself. Such attack will upset the stability of the emulsion, resulting in offensive odours and necessitating replacement of the oil.

The encouragement of good housekeeping in a machine shop pays dividends. The use of contaminated cutting fluids can be hazardous, as has already been mentioned. In particular, the removal of solid contaminants, especially metal particles, is highly important, and the regular cleaning of sludge deposits from machines undoubtedly helps in preserving the good life of a cutting medium. The practice of sterilisation of cutting fluids is not now as common as it was and there is no evidence that it really provided beneficial results.

The psychological effect produced on the operators if the employer takes great care to maintain the cutting fluid in good condition is of considerable benefit. If it encourages the operator to adopt a similar care with his own person, then a good job will be done.

PROTECTION

The last remarks lead to the most important alleviating factor in skin irritation troubles.

The habits of the individual concerned will have a profound influence on his susceptibility to skin troubles. Although women are inherently rather more susceptible to some forms of skin irritation, the incidence of trouble with women operators is generally observed to be lower and this is undoubtedly related to their different attitude (usually) to personal hygiene.

The fact is sometimes overlooked that overalls which become saturated with cutting medium and are left in contact with the skin for hours at a time are just as likely to be the cause of irritation as direct contact with the oil. The intelligent use of splash guards to avoid the clothes becoming saturated and the provision of protective clothing are of obvious benefit.

Barrier creams as a protective applied before the commencement of work is a proven asset, but it is important to note that these creams are not therapeutic ointments. Numerous incidents are on record where a mild outbreak of skin irritation has led to the conscientious, application of barrier creams and this has merely served to produce a "flare-up" of skin irritation of intense magnitude.

Where an operator is affected by skin troubles he should come under medical supervision, when it is the usual practice to remove the operator from the work and to ensure complete recovery before the work is resumed. Once damaged, skin is more prone to future irritation.

The most difficult problem for industry, and for the medical man operating in this sphere, is to decide when a skin irritation complaint is of the compensatable variety. The reasons for this will have been apparent in the previous remarks. It would perhaps be pertinent at this stage to ask whether pre-employment medical grading and job allocation might be more widely practised.

We are indebted to the Castrol Group of Companies for the information in this article, and to Dr. Peter Borrie, Consultant Dermatologist of St. Bartholomews Hospital, London, for his help in preparing it.

Human Element

The Reading, Writing, Managing Engineer

REPORT writing, management and economics—these are outstandingly the three matters most frequently taking up the working time of chemical engineers. This deduction, from the detailed replies to a questionnaire sent to 2,624 corporate members and graduates of the Institution of Chemical Engineers, is drawn by R. Edgeworth Johnstone, the Lady Trent Professor of Chemical Engineering in the University of Nottingham.

The main purpose of Professor Johnstone's inquiry was to provide an objective foundation for the new chemical engineering course in the university. His paper, *A Survey of Chemical Engineering Education and Practice*, given to the Institution last month, recalls the survey carried out by the American Society for Engineering Education.

This report, published in 1955, recommended that the appropriation of time in college engineering courses should be approximately:

	Per cent
Mathematics and Basic Sciences	25
Engineering Sciences	25
Engineering Analysis, Design and Technology	25
Humanistic and Social Studies	20
Optional Subjects	10

(This is for general guidance and the figures in the report were not meant to add up to 100.)

The scheme was based on inquiries conducted over a number of years among engineering colleges, professional bodies and industrial firms in the United States. Professor Johnstone points out that, while deserving the highest respect, all this informed, experienced and learned opinion is still—opinion.

What Professor Johnstone set out to do, in the terms of his covering letter to the chemical engineers, was "to find out how frequently the various academic subjects are used by chemical engineers in their day-to-day practice."

This, undertaken by the use of 24 headings on a reply-paid postcard, was similar to the task which Mr. F. B. Roberts, Editor of ENGINEERING, set himself in touring Imperial Chemical Industries' plants discovering exactly what engineers of ICI do (they employ 2,000 engineers). The outcome of that tour, with its journeys around the United Kingdom and hours of listening and questioning, is the booklet for ICI—*A High Degree of Engineering*.

This journal's Editor found much report writing going on, and its corollary, the studying of reports by engineers investigating the performance of plant and preparing for new projects. One of the engineers appearing anonymously in *A High Degree of Engineering* was programming a computer for calculations on the heating of steel slabs, another drawing up a large data sheet on the design and performance of agitators. By enabling other engineers in the future to select the plant most appropriate for a specific task, time and effort would be saved.

Economics and Reports

Professor Johnstone's survey of the chemical engineers produced a series of answers that correspond with the findings of Mr. F. B. Roberts's journey through ICI.

The 24 sciences or techniques shown in the table were listed in that order on the questionnaire and from the 1,865 replies (71 per cent of those sent out) it has been estimated that report writing, management, and economics occupy from a quarter to a third of the chemical engineer's time, and possibly more.

When the 24 headings are arranged in order of most usage, with report writing, management, and economics leading in that order, it appears, not surprisingly, that in the breakdown of graduates, associates and members, management is the first time consumer of the associates and the corporate members, and report writing is first for the graduates. For both the associates and members, report writing appears in second place; in the case of full members, report writing is equal second with economics, including financial and cost control and analysis techniques; economics also runs a close third in the case of the associates.

For graduates, second place is taken by unit operations, third by heat transfer and fourth by instrumentation and control.

The order of most usage for "all correspondents" ran: Report writing, management, economics, unit operations, instrumentation and control, materials of construction, heat transfer, organic chemistry, inorganic chemistry, fluid mechanics, physical chemistry, fuel technology, machine design and drawing, mass transfer, a foreign language, thermodynamics, physics, electrical engineering, statistical methods chemical kinetics, calculus, theory of structures, computer programming, vector analysis.

The relative frequency of the first three in the list is overwhelming compared with subjects near the bottom. Corporate members have a "frequency of usage" of 13·5 per cent on management matters, 8·9 on writing reports and 10·1 on economics. On fluid mechanics they average 2·2 per cent, on chemical kinetics 1·2 and on computer programming and theory of structures 0·5 per cent each. Vector analysis accounts for only 0·1 per cent.

Curriculum Conclusions

Among graduates the relative frequency figures are 9·2 per cent on unit operations, 8·9 on report writing and 8·5 on heat transfer.

Professor Johnstone has converted the picture he has obtained of how a chemical engineer divides his day into tentative curriculum times for the new course. The result is a curriculum very similar to that recommended by the Institution of Chemical Engineers in its "Scheme for a Full-time Course," with the difference that there is less pure science and more time for social science and communication.

While maintaining the proportion of time for chemical engineering science in a curriculum as proposed by the Institution (42 per cent), more or less the same (45 or 44 per cent), Professor Johnstone's estimate brings communication up from 2 per cent to 6 and elevates social science (taken as covering management and economics) from 2 per cent to 6 or 19 per cent, depending on whether the bias is towards "pure" or "applied."

School Level Chemistry

An intriguing sidelight is provided by Professor Johnstone, who included in his paper some observations based on the office diary he has kept over the past 28 years in industries engaged in petroleum refining, plant design and construction, explosives manufacture and nuclear technology. In the course of the analysis of the diary it became clear that a large part of the chemistry, physics and mathematics used in his day-to-day engineering work was below university entrance standard.

Other practising chemical engineers with whom Professor Johnstone has discussed this have found the same thing.

Numbers using each Science or Technique

Science or Technique	Graduates		Associate Members		Members		Total number	Usage per cent
	Once	More often	Once	More often	Once	More often		
Organic Chemistry	86	135	136	222	52	113	744	39·9
Inorganic Chemistry	91	126	133	198	55	96	699	37·5
Physical Chemistry	100	109	120	184	48	90	651	34·9
Thermodynamics	57	50	90	84	27	64	372	19·9
Chemical Kinetics	34	21	52	33	20	19	179	9·6
Physics	45	51	67	85	34	48	330	17·7
Calculus	47	35	35	23	7	15	162	8·7
Vector Analysis	4	5	2	1	2	2	16	0·9
Statistical Methods	54	35	84	48	30	28	279	15·0
Computer Programming	16	11	18	10	13	6	74	4·0
Fluid Mechanics	93	190	37	174	34	36	664	35·6
Heat Transfer	124	233	193	271	68	81	970	52·0
Mass Transfer	63	95	88	125	25	41	437	23·4
Unit Operations (one or more)	112	260	129	370	43	123	1,037	55·6
Instrumentation and Control	120	208	196	280	66	149	1,019	54·6
Materials of Construction	158	150	213	296	64	115	996	53·4
Fuel Technology	50	110	78	99	46	60	443	23·8
Theory of Structures	25	4	35	7	6	8	85	4·6
Machine Design and Drawing	71	78	91	124	23	51	438	23·5
Electrical Engineering	64	30	103	47	30	22	296	15·9
Economics	122	180	134	393	37	209	1,075	57·6
Management	45	240	50	592	26	286	1,239	66·4
Report Writing	193	223	261	354	77	169	1,277	68·5
A Foreign Language	62	33	99	72	75	55	396	21·2
Totals	1,836	2,612	2,544	4,092	908	1,886	13,878	—

Sharp Increase in Building Apprentices

The number of building trades apprentices indentured in London last year was a third greater than in 1959. This information was given by Mr. E. J. Cook, president of the London Master Builders Association, speaking at a luncheon on the occasion of the association's annual general meeting. An important contribution to the industry's apprenticeship scheme, which is operated by the National Federation of Building Trades Employers (NFBTE), is made by the medium and smaller firms—a pleasing contrast to other industries where the large firms have to set the pace and are constantly losing their best apprentices to small companies who do nothing to help with training.

Technical Teachers

Mr. Cook said that he thought a limited amount of evening school instruction was desirable for one very important reason. It enabled the more senior and competent technical staff within the industry to undertake teaching, which would otherwise be impossible without substantial cost and interference with their business commitments.

Mr. Cook raised the vexed issue of direct labour—the building labour that is employed by local authorities, nationalised industries and similar bodies. Out of a total labour force in the building industry of 1¼ million men, 300,000 were employed in direct labour undertakings, and of these 186,000 were in the employ of local authorities.

It was incongruous, particularly in the field of new building, that such a considerable volume of construction should be denied to an expanding industry. The Government had indicated its intention to support private enterprise and should not ignore the serious reduction in work load that this situation imposed on the industry.

Good Ministry Drawing

With Mr. R. H. M. Thompson, M.P., the Parliamentary Secretary to the Ministry of Works, sitting next to him, Mr. Cook had a good word to say for the MoW.

The Ministry had set a good example in its operation of the firm price tendering procedure. He also complimented the department on their adequate documentation and detailed drawing preparation. This good example was not always emulated by other Ministries, local authorities or the nationalised industries—or, for that matter, by architects and private clients. Poor practices in the preparation of documents was of serious concern to the builders. All their efforts to improve working efficiency were nullified, particularly where firm price procedure applied, if the design processes were not properly undertaken.

Complete Range of Industrial Frames from Tubes

A new range of tubular steel components for pre-fabricated buildings has been launched by Tubewrights Limited, the Stewarts and Lloyds subsidiary, of Egginton House, 25 Buckingham Gate, London, SW1. The range comprises trusses of up to 80 ft span, columns to give clear heights of 8 to 20 ft by steps of 2 ft, and sheeting and purlin rails of 3 in and 3½ in diameter tubes for 12 ft 6 in and 15 ft column spacings. Components are also available for "umbrella" construction, comprising trusses of 40 ft and 45 ft span, spine girders 75 ft, 90 ft and 105 ft long, and columns to provide clear heights of 16 ft or 20 ft. The makers believe that the combination of the components will meet most, if not all, structural requirements for pitched roof industrial buildings. All site joints are bolted.

Particular advantages claimed for tubular structures are low weight (and therefore low costs) and rapid erection; clean lines which give a good appearance and improve the lighting factor; and maintenance costs, particularly for cleaning and painting, are also lowered because tubular sections have surface areas as much as 40 per cent less than other steelwork.

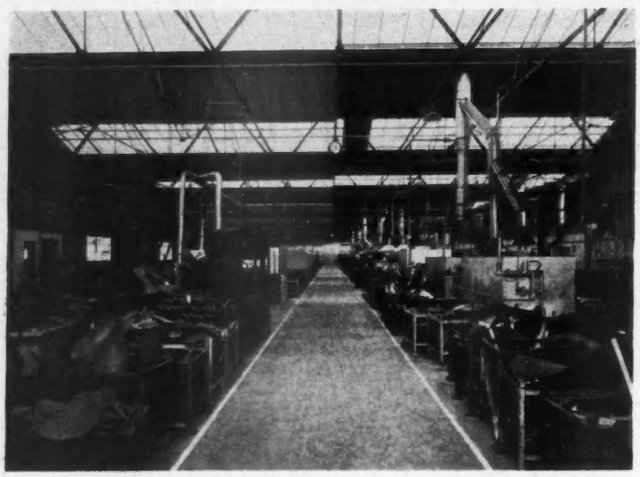
Warren type bracing has been adopted for the spans of 30 ft and 45 ft and these trusses are supplied in one piece. For the intermediate spans of 40 ft, 45 ft and 50 ft, Fink bracing has been used and the trusses are sent in two parts with loose centre ties for bolting together on site. The longer trusses, above 60 ft span, are of the trussed rafter type and are also supplied with loose ties and hangers ready for site bolting.

The general details of the components are in accordance with BS 449 (1959) "The Use of Structural Steel in Buildings" and CP 3, chapter 5 "Loading." Dead load of the roof sheeting, including insulation, has been taken at 6 lb per sq. ft and an allowance made for a live load of 15 lb per sq. ft, plus 13 lb per sq. ft for wind loading with a normal permeability allowance.

In addition, a service load can be carried on the roof steelwork. This is generally ¼ ton carried simultaneously at each truss line along a girder, though for the umbrella buildings, when the 75 ft and 90 ft spine girders are supporting 40 ft trusses, this figure can be increased to 1 ton.

The first of the umbrella buildings has already been completed at Chesterfield for S. and J. Litchen Limited, manufacturers of agricultural and general engineering machine parts. The factory is 480 ft long and has an unobstructed width of 90 ft. Though work was spread over several weeks, erection of the frame took only five men less than two days. Twelve bays, each 40 ft by 90 ft, were lifted by a crane and bolted into position at the rate of one every 50 minutes. The steelwork for the roof had been bolted together at ground level in a little over three days by the same men to avoid working at height. A feature of the main shop building is that the roof structure will support three monorail systems (2 ton hook loads) and these are contained almost wholly within the roof, reducing the available headroom by only 6 in.

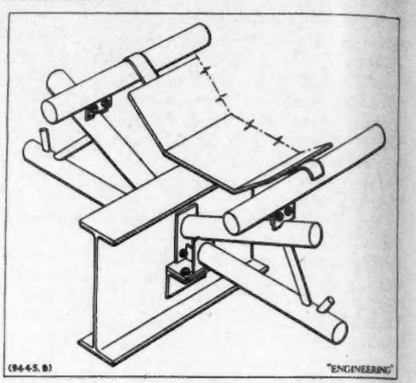
The Chesterfield building was erected and clad by Tube Construction (Bristol) Limited for the general contractor, Geo. F. Kirk Limited of Chesterfield.

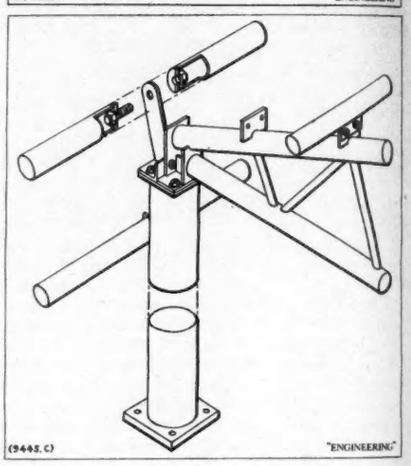


(Left) The "umbrella" roof under construction at Chesterfield using standardised tubular components. The roof covers a floor of 43,000 sq. ft, but took five men less than two days to erect.

(Right above) Tubewright's standard trusses and purlins supported on an RSJ valley girder. The asbestos gutter (24 in by 6 in by 9 in) is carried along a standard 3½ in by 10 swg purlin.

(Right below) Eaves column supporting a truss and sheeting rails; the connection for the rails is shown in the exploded view.





Load Bearing Capacity of Ice Covers

Frozen lakes and rivers are used widely in Canada for transportation purposes. It is therefore important to be able to predict the load that can be put safely on the ice.

The properties of an ice cover are determined to a great extent by its history of formation, including the temperature changes to which it has been subject. Often, an ice cover consists of a lower layer of good clear ice in contact with the water, and an upper layer of white-coloured ice which results from the freezing of a snow-water mixture. This white ice is not as strong as the good clear ice.

Under some conditions, a water or slush layer will be found at the ice surface or within the ice cover. When the ice cover is subject to temperature changes and wind action, cracks will form, some of which may be open. Such defects in the ice cover, though they may be predictable, are not normally subject to control. These defects affect the geometry of the cover and the properties of the ice, both major factors in determining the bearing capacity.

As is often the case in such circumstances, recourse is made to an empirical approach. Those who use ice covers continuously for transportation purposes develop through experience a knowledge of the load that can be transported safely over ice of given thickness and quality. Unfortunately, this experience gained in the field is rarely recorded and therefore not generally available.

Pulp and paper companies make continuous use of frozen lakes and rivers in their logging operations. With the assistance of the Woodlands Section of the Canadian Pulp and Paper Association, the Associate Committee on Soil and Snow Mechanics of the National Research Council of Canada undertook a project to record some of the experience of this industry in their use of ice covers. A form was prepared upon which companies could record relevant details whenever a vehicle or horse broke through the ice. A second form was prepared which asked for the maximum load that was successfully placed on the ice and the associated ice thickness and quality. These forms were distributed to the pulp and paper companies in the autumn of 1958. The survey has now been conducted for two winters, 1958-59 and 1959-60, and a paper describing the results obtained was presented to the 1960 Annual Meeting of the Woodlands Section of the Canadian Pulp and Paper Association. Copies of this paper, NRC 5712, can be obtained from the Division of Building Research, National Research Council, Ottawa.

The survey has shown that ice thickness should never be taken as the sole criterion for its safe bearing capacity. If the full bearing capacity is to be utilised, careful attention must be given to the quality of the ice, to the presence of cracks and to the thermal history of the cover. The effects of some of these factors have been discussed in a general way by many authors from the analytical point of view. For example, it has been shown that the bearing capacity near the edges of an ice cover with a free edge is about one-half the capacity well away from the edge. This knowledge can be a very useful guide to operations in the field.

One area of experience that has not been recorded as yet is the loads that many companies place on ice covers on a routine basis without mishap. Forms are now being distributed on which such information can be recorded as well as the associated ice thickness and condition. These observations, when combined with the breakthrough and maximum load observations, should define empirically the safe and unsafe conditions and their region of overlap.

McKay Creek Power Station Commissioned

Since May, 1960, the State Electricity Commission of Victoria, Australia, has put 96 MW of generating capacity into service at its new McKay Creek hydroelectric power station on the slopes of Mount McKay in the Australian Alps. The station forms part of the Kiewa hydro-electric scheme.

The first of six 16 MW generator sets supplied by Associated Electrical Industries Limited (Heavy Plant Division) was commissioned at the beginning of May, and the last has just been put on load. Erection of the generators is

Erecting the six AEI 16 MW generators in the McKay Creek hydro-electric power station, Australia.

shown in progress in the Electricity Commission's photograph reproduced here. Three of the four power stations planned for the Kiewa scheme are now in operation, producing nearly 184 MW.

The McKay Creek power station, which is situated underground, is supplied by Australia's highest reservoir, Rocky Valley, 5,000 ft above sea level. The station is controlled from Mt. Beauty, a township 17 miles away. Water for the Boving turbines is conveyed through nearly three miles of tunnel, then by surface pipeline and finally through a steel-lined pressure tunnel, 630 ft long. The turbines work under a head of more than 1,700 ft. After use the water is discharged into the East Kiewa River, where it supplies the turbines of No. 3 power station; then, passing under the mountains, it is used again to drive the turbines of No. 4 power station, on the West Kiewa River.

Power is supplied to Melbourne, 153 miles away, at 220 kV.

Questions and Answers on Coastal Defence

What action should an engineer take when apparently no material is arriving on a beach and the level of the beach continues to fall over several years?

Artificial feeding of the beach is probably the only way of providing material on such a site. The quantity of material required depends on the new profile, though little information is available on the rate at which the sands need to be replaced—clearly it depends on the exposure of the beach. Case histories cover beaches losing as little as one-fiftieth of the fill annually and another, on a German island in the North Sea, where 31 per cent was lost in the first year but the rate of loss fell so that seven years later 34 per cent of the tipped material still remained. Artificial nourishment with shingle would be more economical of material than would sand because the littoral drift would be less.

Groynes are generally ineffective in building up a beach where at each tide it is covered by several feet of water. The explanation may be threefold: exposure of the wall causes erosion, the groynes do not collect what drift there is, and the littoral drift may be small.

Such problems as those above are discussed in question-and-answer form in a publication just issued by the Department of Scientific and Industrial Research. It is the Hydraulics Research Paper No. 3, *Coast Erosion and Defence*, prepared by the staff of the Hydraulics Research Station at Wallingford and obtainable from HM Stationery Office (1*s* 3*d*).

The booklet is only 14 pp. plus vi, and within this space tackles nine questions including the one quoted. All nine are strictly practical and the answers are based on experience as well as the results of experiments at Wallingford. The language is intentionally free from scientific jargon.

In discussing some experiments on permeable groynes, it is observed that such constructions had no influence on the littoral drift where the drift was greatest, i.e., along the upper beach. They did, however, reduce the small drift that was found near low water. Permeable groynes will build up a beach and it is believed that the accumulation begins several hundred feet up-drift of the first groyne, raising a bar of fine sand near the low water mark which then extends along the whole system. The bar then moves slowly inshore to build up the upper beach.

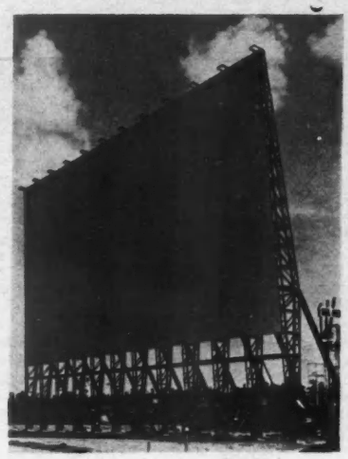
Steelwork for "Drive in" Cinema

The unusual steel structure shown in the illustration is to support the screen for Trinidad's third "drive in" cinema. The steelwork has been fabricated and exported by Sanders and Forsters Limited, of Barking, Essex, the structural company of the Chamberlain group of companies.

Set at an angle of 7° to the vertical, the structure consists of twelve ribs, each 74 ft high with horizontal steel channel members stretching across the full width to support the flat asbestos sheet screen, which measures 110 ft wide by 54 ft deep.

The steelwork, which was specially designed by Sanders and Forster's own staff, is of all-welded construction and arrangements were made for the minimum amount of simple site bolting to facilitate easy erection. The ribs are vertical cantilevers and each rib member was broken down into three convenient sections for transport. The sides of these sections were fully prefabricated leaving only the front and back lacing members to be site bolted to form the complete "box." This method of design and breakdown permitted the whole structure weighing approximately 30 tons, to be shipped flat, occupying relatively small cubic area in relation to the weight.

To support a bosun's chair or cradle for general maintenance work and repainting the screen's surface, a small cantilevered angle



Screen for a "drive in" cinema.

frame has been located at the top of the screen.

The design of the concrete foundations on which the structure is mounted was carried out by the Trinidad office of Clarke, Nicholls and Marcel, the consulting engineers, and the caps of the concrete foundation blocks at the rear of the structure were specially inclined at an angle to accommodate the twelve battened channel support members.

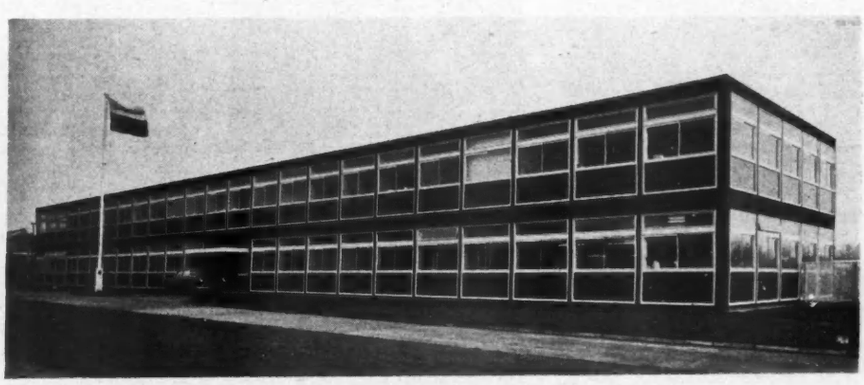
The complete structure has been designed to withstand a wind of 85 mph.

Contractor's Research Centre Opened

The research centre for the Cementation Group has been opened at Maple Cross, near Rickmansworth, Hertfordshire. The building is to act as the permanent headquarters for the Group's research. The centre comprises offices and laboratories on two floors, and it covers some 18,000 sq. ft. The work of the centre is divided into four main sections—civil engineering, mechanical engineering, physics and chemistry. Dr. R. A. Scott, F.Inst.P., who was formerly with Metropolitan Vickers at Trafford Park and then Henry Simon of Stockport, is in charge.

Although Cementation's activities are very wide, the group is particularly concerned with foundation engineering. A great deal of the centre's work, therefore, will be directed at the behaviour of soils, the way in which their mechanical properties can be altered, and various aspects of grouting. Laboratories of the group's soil mechanics section are also accommodated in the new building.

The centre was constructed by the Demolition and Construction Company Limited, a member of the group; the group's design department acted as structural engineers, and the architects were C. H. Elsom and Partners.



The research centre of the Cementation Group.

MULTI-SPEED GEARBOX

Equal Step Settings

A NEW multi-speed gearbox, the Arithmic, which the manufacturers confidently believe could replace the infinitely variable drives now used on many machines, is being made in this country.

Unlike infinitely variable speed drives, it gives positive equal step settings which can be exactly repeated. All the speeds are in arithmetical progression and can be arranged for 21 speeds with a 2 : 1 range, or 24 speeds with a 24 : 1 range. Used in conjunction with an additional change speed gearbox the range of useful speeds can be multiplied, one regular combination giving 84 speeds in an 8 : 1 range.

Two sizes are at present in production, rated at 10 and 30 hp at a nominal 1,000 rpm input, and standard reversing gearboxes are available with shaft heights and centres to match the Arithmic boxes. These reversing boxes can include reduction ratios from 1 : 1 to 3 : 1, and can include electrical interlocks in the change lever. The

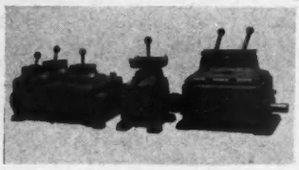


illustration shows a straight forward Arithmic gearbox unit.

The makers say that gears are of heat treated alloy steel and are machine cut with sliding gears mounted on spline shafts. All bearings are of the ball or roller types. The cases are of cast iron with oil seals on all external shafts. Bronze selector fingers with what the makers describe as adequate locating mechanism, together with mechanical interlocking and ball change levers, are used for gear shifting.

Power ratings, as outlined above, are said to take account of shaft deflections, spline lengths and bearing loads in addition to tooth wear and strength characteristics. The makers consider that applications will be found especially in the wide field of materials processing. *Mattersons Limited, Shawclough, PO Box 31, Rochdale, Lancashire.*

FILTER ASSEMBLIES

4,500 lb per sq. in Differential Pressure

THE first filter assemblies designed and manufactured to the envelope and requirements of American specification Mil-F-8815 have been completed and delivered to Grumman Aircraft Engineering Corporation for use on the A2F airplane.

All the filters, for which the complete assemblies are shown, are rated at 15 microns absolute which means that maximum particle size which is passed is 15 microns. Nominal ratings are done away with by the specification.

The filter housing is of aluminium and is designed to operate at 3,000 lb per sq. in with a proof pressure of 4,500 lb per sq. in and a bursting pressure of 7,500 lb per sq. in. Operating temperatures range from −65 to 275° F, with a minimum design operating life, at 275° F, of 1,000 hours. All filters include Deltadyne differential pressure indicators set to actuate at 80 ± 10 lb per sq. in, with a low temperature lockout. All elements use Supramesh filter medium, are designed to withstand

4,500 lb per sq. in differential pressure, and are cleanable.

A feature of this design included on all units is an automatic shut-off when the filter bowl is removed. This is said to permit elements being removed and replaced while the system remains sealed against fluid leakage or air inclusion. It also allows reservoir pressure to be maintained during filter change. *Aircraft Porous Media Inc., Glen Cove, New York, NY, USA.*

FLUID FILTER

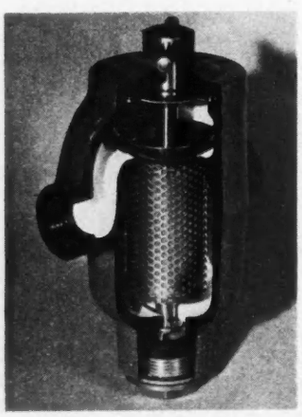
Full Flow Action

JUST announced is a new range of single and double chamber filter units ranging in size from ¼ in to 8 in for the single and ½ in to 6 in for the double.

Known as the Uniplex and the Biplex respectively, the new filters are designed to remove solids in suspension from all kinds of fuel and lubricating oils, petrol, glycerine, coal tar liquids and water, without creating an undesirable pressure drop.

The internal arrangements and section of the filter itself differ only between the two size ranges ¼ in to 1¼ in and 2 in upwards, and are not affected by whether the unit is a Uniplex or a Biplex. The illustration shows a Uniplex in the lower size range.

The internal Plex filters are designed for easy dismantling and good sealing. The Biplex permits one filter to be withdrawn for cleaning while the other is in use, and the manually-operated control valve is so designed that there is no interruption of flow during change-



over. It is impossible, even accidentally, to shut off the flow from both chambers simultaneously.

The new range is designed for a maximum pressure of 150 lb per sq in and temperatures up to 248° F. *Zwicky Limited, Buckingham Avenue, Slough, Buckinghamshire.*

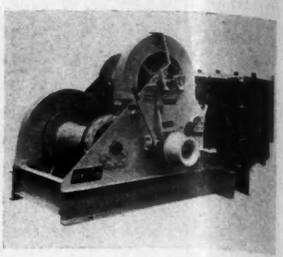
WINCH

Lifting Load 10 Tons

A NEW double barrelled geared winch, the model 8TC, with a lifting capacity of 10 tons has now been introduced.

Power is supplied by a radiator cooled Lister FR6 diesel engine developing 48 bhp at 1,500 rpm. It drives through a British Twin Disc torque converter that will withstand heavy shock loading and will transmit up to 650 lb-ft. In this unit the pump is integral and a self-governing circuit is employed. The converter is mounted on an extension of the engine shaft. The drive is taken from the torque converter output shaft by means of a composition silent pinion to a double reduction gearing. The use of the converter gives great flexibility to the winch, enabling operation at creeping speeds or even stalled for accurate positioning.

A drop hammer may be operated from the upper barrel as in other winches in the range. The lower front barrel is employed for heavy loads at low speeds. The diameter of the piling



barrel is 14 in and the effective length is 18½ in. The maximum drop hammer load for piling duties is 4½ tons at a working speed of 120 ft per minute. The lifting barrel is 12 in diameter and has a length of 31½ in. The maximum design loading for this barrel is 10 tons at a hoisting speed of 60 ft per minute.

The winch has an overal length of 9 ft, a width of 7 ft 6 in and a height of 6 ft 4 in. The total weight with the engine is 5 tons 7 cwt. Winch and engine are mounted on welded channel framework to make a single compact unit. All controls are conveniently grouped for ease of operation. *Henry Sykes Limited, Southwark Street, London, SE1.*

SCINTILLATION COUNTER

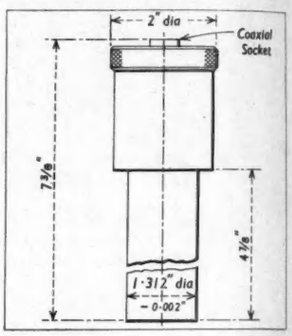
Gamma and X-Rays

A SCINTILLATION counter has been developed for use within the range 0·4 Å to 3·5 Å, where resolving times of about two microseconds are needed.

This transducer consists of a Hilger and Watts crystal of thallium-activated sodium iodide, coupled to a sensitive photomultiplier—the EMI type 9524A. The housing in which the two components are mounted also contains the appropriate circuitry for the dynode chain.

The crystal, of 1 in diameter and 1 mm thick, is set in a demountable aluminium cylindrical container with a window at the top and bottom. The window, through which the radiation passes, is made of beryllium while the other window, which couples the crystal to the photomultiplier, is of spectacle crown glass. Between the crown glass window and the crystal is a thin film of silicon fluid. Magnesium oxide surrounds the top of the crystal to prevent absorption of the scintillation.

The EMI photomultiplier has a working



voltage of about 1·3 kV and a load of approximately 0·3 mA down the dynode chain. It gives more than 70 microamps per lumen at the cathode.

There are numerous applications for the device in gamma and X-ray work, including X-ray diffraction detecting with a recording diffractometer; X-ray fluorescence analysis with a suitable spectrometer (when the circuitry includes a pulse-height analyser); and measuring the energy of gamma radiations. *Hilger and Watts Limited, 98 St. Pancras Way, Camden Road, London, NW1.*

SQUARE-WAVE GENERATOR

Self-Calibrated

SQUARE-WAVE unit type SW98, made by a Servomex Controls's subsidiary, provides a square-wave driving signal for repetitive analogues.

A square-wave at mains frequency is provided. The unit also generates square-waves from externally applied sine waves over the frequency range 50 c/s to 10 kc/s. The rise time is about 2 microseconds for any operating frequency and a mark-space ratio trim is provided to enable an exact 1 to 1 ratio to be obtained.

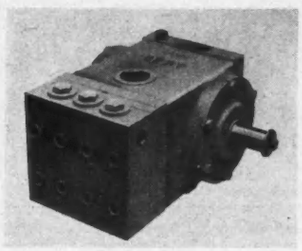
The minimum external signal for satisfactory operation is 2 volts peak, and the output is continuously adjustable from 0 to 50 volts peak-to-peak, independently of the input amplitude.

A tuned circuit has been incorporated to generate a calibration oscillation for time measurement on an oscilloscope trace, for use with repetitive analogues. The calibration frequency is 2·5 kc/s, and the oscillation train may be switched to occur during either the positive or negative half of the square-wave.

The unit is designed for mounting with other units in a bench rack, but it can also be stood separately on a bench. *Feedback Limited, Crowborough, Sussex.*

HYDRAULIC PUMPS

7,100 lb per sq. in Maximum Pressure



REASONABLY priced high pressure hydraulic equipment known as the Keelavite/Gury range is available in this country. This range comprises a series of fixed capacity piston pumps, and the complementary control valves for the building of complete high pressure systems.

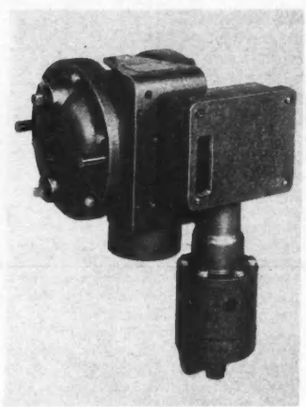
KG series pumps are of fixed capacity and have either three or six pistons operated by a cam mechanism. One of these, capable of 7,100 lb per sq in at 1,500 rpm, with an output of 5·75 gallons per min is shown. An integral cylinder head incorporates an automatic valve system for controlling the oil flow in the unit. The pump body is of forged steel and is available for foot or flange mounting. (The one shown here is foot mounted.) There are nine basic sizes, but by varying the piston bore and stroke, a total of 22 different volumetric outputs are obtained, from 0·28 gallon per min at 100 rpm, to 44 gallons per min at 1,500 rpm. Pressures at 1,500 rpm range from 2,200 lb per sq. in to 7,100 lb per sq. in for intermittent service, suitable for such machines as presses.

A feature of these designs is the simplicity of their mechanical parts. With high volumetric efficiencies of about 94 per cent, they are said to be remarkably silent in operation. The KG pumps are available as double pump units and motorised pump sets are made using BS electric motors as prime movers.

Forged steel valves for directional control, relief and combined off-loading and by-passing are available, and will be followed shortly by several other types including back pressure and pressure-reducing valves. *Keelavite Hydraulics Limited, Allesley, Warwickshire.*

FLOW TRANSMITTER

With Remote Indications



THE Model 11A Flow Transmitter is designed to measure the differential pressure on a liquid passing through an orifice and to transmit a pneumatic signal directly proportional to the input.

This transmitter is built to withstand wear and tear, and an interesting feature is the mechanically-linked local indicator, which gives a true indication of differential pressure or flow, and is completely independent of air supply. Also used is a well proven differential pressure unit using stainless steel bellows with full overload protection.

The instrument can be connected directly to an orifice in most cases. It can also be used without additional equipment for measuring and indicating liquid level, interface level, specific gravity and other process variables expressed in terms of a differential pressure.

Standard ranges are 0-25, 0-50, 0-100, 0-150, 0-200, 0-300, 0-400, in w.g. differential. Ranges up to 50 lb per sq. in are available, as also are centre zero ranges and positive and negative suppression. Air consumption is not more than 0·12 SCFM (dead end service in balance) and a change in supply of up to 5 lb per sq. in does not change the output by more than 0·1 lb per sq. in. *Associated Electrical Industries Limited, Instrumentation Division, Crown House, Aldwych, London, WC2.*

PORTABLE AIR COMPRESSOR

Single Cylinder

A FURTHER multi-purpose fully mobile unit has been added to the range of portable air compressors for general use.

The "PD three" is a single-cylinder air-cooled compressor which displaces 2·58 cu. ft at 100 lb per sq. in and incorporates a moisture separator and pressure gauge. It is directly coupled to a ½ hp electric motor, and the unit is secured to a welded tubular steel frame mounted on rubber wheels. The tubular steel handle is fitted with carrier brackets for the hose and cable.

With the number of working parts reduced to a minimum, the only attention necessary is occasional topping up with a light air compressor oil. A Thermotrip cutout device is included to protect the motor against overload or burnout, and a "Vari-Pressure" control valve allows rapid choice of operating pressure for any required duty by hand manipulation of a milled adjusting nut. The unit is supplied with a 15 ft length of $\frac{5}{16}$ in diameter (inside) air hose with ferruled connections, tyre chucks, and 15 ft of 3-core CTS electric cable. The IM spray gun, shown hanging on the handle of the machine, is suitable for use with the "PD three"; it uses the internal mix principle and works at a comparatively low pressure with small air consumption. *BEN Patents Limited, High Wycombe, Buckinghamshire.*

TRANSISTOR POWER UNIT

Small and Reliable

A SIMPLE method of obtaining power supplies for transistor circuits is provided by a new range of standard electronic sub-assemblies.

Each of the four sub-assemblies is transistorised for reliability and compactness, and has been designed with wide safety margins.

The range comprises two unstabilised units with outputs of up to 1 and 5 amps respectively, adjustable in 3 volt steps from 0 to 39 volts; a 250 mA stabiliser with a stability factor of 200 to 1 for mains variations between +10 per cent and −15 per cent of the nominal; and a series regulator unit.

The unstabilised units may be used alone when the circuits to be supplied are insensitive to power supply variations, or when the cost is a paramount consideration. For applications requiring stabilised currents, the stabiliser or series regulator unit can be added.

The maximum voltage from combinations incorporating the stabiliser or series regulator units is 30 volts. Coarse control of the output voltage is governed by adjustable taps of the mains transformer of the unstabilised units, and fine control is by a preset potentiometer.

In addition to its main output, each of the unstabilised units has two subsidiary outputs. Those of the 1 amp unit provide 200 mA at 6, 12 and 24 volts and 20 mA at 36 volts; those of the 5 amp unit provide 1 amp at 6, 12 and 24 volts and 100 mA at 36 volts. *Mullard Limited, Mullard House, Torrington Place, London, WC1.*

RAIL CRANE

20 tons Capacity

RECENTLY added to an existing range of 20 ton mobile and lorry-mounted cranes is a railway version, the Jones KL 12-20R.

The lifting capacity is again 20 tons at 10 ft radius, using the standard 30 ft jib, and a shunting capacity of 150 tons is quoted for the normal chassis. A permanent way chassis, to permit travelling in train, is also offered.

The standard power unit is a Perkins Four 270D diesel engine, and transmission to the various crane motions is direct mechanical. The controls are pneumatically-operated to ensure finger-tip precision in the handling of a wide variety of loads.

The crane illustrated has been fitted specially with a 54 in diameter electromagnet for handling pig and scrap iron. In this instance a separate magnet generator has been installed on the far side of the slewing superstructure, and its radiator can just be seen. Alternatively, magnet equipment of smaller capacity can be supplied, using a generator powered by the crane's own engine. Disconnection of the magnet to allow the crane to be used for general lifting duties is quick and simple. The KL 12-20 R is built at Letchworth by K and L Steelfounders and Engineers Limited. *George Cohen Sons and Company Limited, Wood Lane, London, W12.*

CONCRETE DUMPER

3 cu. yd Capacity

A NEW concrete carrying dumper has been successfully tested under arduous conditions.

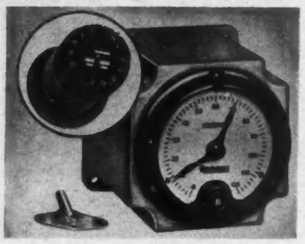
The Muir-Hill 14B has a liquid capacity of 3 cu. yd and is designed to carry concrete between batching point and placing point, being particularly suitable for projects where the hauling distance is too short to warrant the use of agitators or mobile mixing plant.

The new dumper has shown an ability to deal equally well with concrete of differing moisture contents. It has a tipping lift of 4 ft 1 in under the body lip, which is suitable for discharge into standard 1 cu. yd and 2 cu. yd concrete tremie buckets and concrete pump hoppers. A discharge chute to facilitate placing at ground level can also be supplied.

Power is provided by a Perkins P6 diesel engine developing 66 bhp at 1,800 rpm and a maximum torque of 184 lb-ft at 1,200 rpm. There are four forward speeds ranging from 3·25 to 17·15 mph, and four reverse speeds ranging from 2·31 to 12·2 mph. *E. Boydell and Company Limited, Elsinore Road, Old Trafford, Manchester 16.*

PROCESS TIMER

Choice of Ten Time Ranges



LONG life without loss of accuracy, even when used continuously, day and night, in tropical or other adverse conditions, is claimed for the Mark II Rodene "7000" process timer.

The changes from the Mark I include new materials, such as "Alkyd" for the contact actuators, and the replacement of the friction drive by a new free-wheel which picks up within a tenth of a degree and gives a solid forward drive.

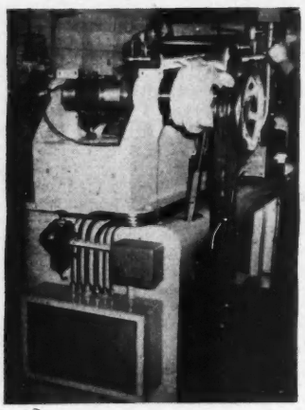
The motor now has a larger coil wound on a moulded nylon bobbin, which raises the maximum voltage to 440. The Mark II gives a choice of ten time ranges with full-scale readings of ½, 1, 4, 12, 36 or 72 minutes and 3, 12, 24 or 96 hours. The unit is available for flush or projection mounting and the removable key (illustrated) can be provided instead of a fixed setting knob.

Also to be seen in the illustration is the new moulded base. This allows bigger screw-type terminals in wire-retaining recesses, permitting better "creeps and jumps" figures. It also allows more connections to be brought out, thereby increasing the flexibility of use. For instance, the clutch can now be fed from a separate dc source to prevent resetting on mains failure or during breaks in an intermittent process.

This timer can be connected to start when a switch is closed and to reset instantly when it is opened, or it can start on a pulse and reset automatically. The output contacts can be operated for the duration of the timed period, or from the end of the timed period until the timer is reset. It also provides a pulse at the end of the timed period to lock up a contactor or start a further timer. *D. Robinson and Company Limited, 717 London Road, Hounslow, Middlesex.*

FOIL PRESS

Photo-electronic Control



A HORIZONTAL foil press designed for the production of aluminium foil cups and trays incorporates photo-electronic controls.

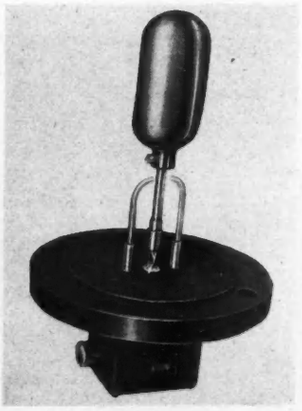
The press, which will accept aluminium foil rolls up to 16 in wide, has an adjustable through feed of up to 10 in and will operate at 50, 75 or 100 strokes per min. Alternatively, a variable speed drive can be fitted. The die plate has been designed so that several cups can be pressed at one time. These then fall into a space below the machine where they can be either stacked or carried away on a conveyor.

The electrical equipment, supplied by Hird-Brown Limited, includes coloured warning lights to indicate motor overload, broken or bent foil, and the end of a batch. The photo-electronic control unit ensures that, should the foil break or bend, the machine will stop immediately. Another safety device stops the press if a foil cup fails to eject from the die set.

The press is intended for semi-automatic operation so that after, a new foil has been fed into the machine, the operator can start it up and leave it until a preset number of strokes have been made. The machine then stops and a coloured signal light is switched on. *H. and T. Mellor (Engineers) Limited, Chapel-en-le-Frith, Stockport.*

ALARM SWITCH

Liquid Level Control



A NEWLY available packless flexible shaft level controller is the Model 26 Liquid-Level Alarm Switch.

This model is of simple design and strong construction, and, though it is a comparatively low-priced instrument, the makers claim for it the accuracy and reliability of expensive switches.

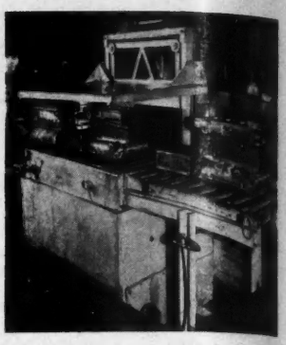
A change in the buoyancy of the displacer operates the switch, instead of using the movement of a float "riding" on a changing liquid level. Any displacer motion is transmitted to the micro-switch by a stiff tongue within the flexible shaft. To ensure that the stress in the shaft is kept within the elastic limit, a limit stop is provided.

The instrument is capable of direct or reverse action and is easy to instal, being mounted on standard flanges. An example of its dependability is the fact that a buoyancy change of less than six ounces causes full actuation of the microswitch.

The housing for the switch and terminal is insulated from the flange by an asbestos gasket, enabling the instrument to be operated at high process temperatures. Indeed, the permissible temperature range extends from minus 65° F to plus 500° F.—*Associated Electrical Industries Limited, Instrumentation Division, Crown House, Aldwych, London, WC2.*

DUNKING MACHINE

Pneumatic Action



A RECENTLY introduced heavy duty dunking machine incorporates pneumatic operation of the entire dunking action, both upwards and downwards.

The machine is intended for applications where soaking and agitation are more suitable than other metal cleaning methods. It is sturdily built for rugged service. It is used, for example, for washing sand from castings and rough cleaning cylinder blocks.

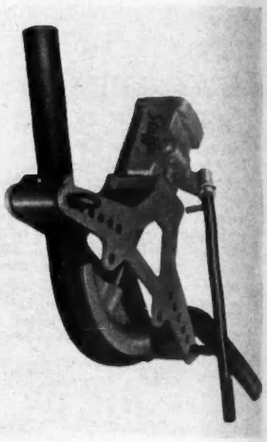
The quick yet smoothly controlled dunking action creates heavy turbulence in the cleaning solution which scours all the surfaces of the parts being processed and penetrates the recesses, loosening and removing the sand, grease and other residues. Operation is straightforward; the parts to be cleaned are transferred on to the dunking table which the operator lowers into the cleaning solution under the control of a valve. When the table reaches the bottom of the tank, dunking starts.

At the end of the cleaning period, the operator reverses the control valve which stops the action and elevates the table. A filtration system can be fitted to the machine which will take solid matter out of the solution continuously.

The machine has been produced as a dual dunking unit for washing and rinsing and is so designed as to enable any number of units and alternative processes to be linked in line. The system could be modified to operate completely automatically. *Dawson Brothers Limited, Ventnor Works, Gomersal, nr. Leeds.*

THREE-POINT PIPE BENDER

1½ in Capacity



A 1½ IN CAPACITY three-point bending machine has been introduced into the Staffa range of pipe, bar and section benders.

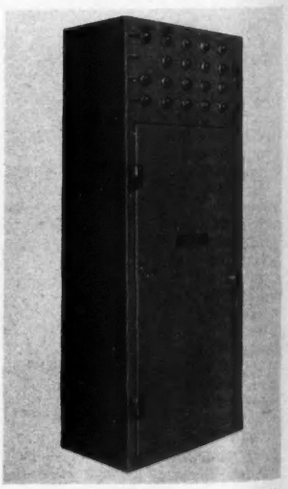
Suitable for a wide range of applications, the machine bends nominal bore steam and gas pipes up to 1½ in. diameter. The bender which has been designated the B2 does not require a bench or a stand. It comprises a powerful hydraulic pump ram unit, a forming head assembly and centre formers for ½ in to 1½ in nominal bore pipes conforming to BS1387. The whole assembly, complete in a wooden case, weighs 100 lb.

A particular feature claimed for the machine is the set of angle-of-bend indication marks cast in one end of the formers which provide a useful guide during the bending operation.

The hydraulic unit permits easy and "one hand" operation. Very little maintenance is required and when an overhaul is due the various seals and washers are easily removed. The machine is much faster than any screw type bender and a full 90° bend can be made in 1½ in pipe in 60 seconds. *Chamberlain Industries Limited, Staffa Works, Argall Avenue, London, E10.*

BIN CONTROLLER

High and Low Levels



A NEW type of controller is now being marketed to provide automatic filling and emptying of bins, tanks and silos.

The model illustrated can deal with up to six bins, filling and emptying being controlled through motorised or solenoid operated valves and high and low level control units in each bin. A cyclic selection device in the console unit samples the signals from the high level controllers in any desired sequence. If the level of material in the bin being sampled is below the high level electrode, the valve will close and the sampling mechanism will start to cycle again. If a bin is already full, the sampling device will pass over it to the next bin in the sequence. A similar process takes place at low level in conjunction with the emptying valves.

A neat indicating panel is incorporated in the console—which houses both controllers and ancillary equipment—and the whole equipment, it is claimed, is designed for easy maintenance. Units can be supplied to cover any number of bins or silos. *Thomas Industrial Automation Limited, Station Buildings, Altrincham, Cheshire.*

Instrumental Tableaux

INSTRUMENTATION plays a vital role in reactor control and safety, which are dependent on the accurate recording of conditions in the core. The construction of a new reactor brings much speculation about the advantages that may be gained over its predecessors from any fundamental differences in the design and the possible economic adjustments that may be foreseen, but the instrumentation is considered an unmentioned ancillary. The development of nuclear power has been accompanied with many useful discoveries in instrumentation which have been profitably exported to other industries. For example, checking that there are no air locks in tooth paste tubes. This closely knitted relationship is illustrated further in the developments recorded below.

Phantoscope

Radiation spectrometry and radiation counter characteristics can be analysed by the use of the phantoscope. The X-ray spectrum of plutonium 239 (Fig. 1) is displayed on a cathode-ray tube using a proportional counter, and the gamma spectrum of uranium 235 by the use of a sodium iodise scintillator probe. Analysis is achieved by sweeping through the pulse distribution of the counter coincident with the display time; base count rates of up to 10,000 cycles per second and time bases from seconds up to minutes may be used. This device may be used to give counter bias and the ERT voltage plateau characteristics quickly.

Gamma Flux Grease Testing Rig

Testing of radiation resistant oils and greases creates many problems, and the Mobil Oil Company in conjunction with the UKAEA, Harwell, have built a test rig called SETRA. The Submerged, Elevated Temperature, irRadiation Apparatus has been operating at Harwell since last June. The source is the fuel element irradiation pond for DIDO and PLUTO elements, in which a high gamma flux is obtained. The apparatus consists basically of an electric motor which drives, via a long shaft, a test gearbox. The gears drive a shaft at 900 rpm, on which are mounted four test bearings contained in housings. The whole apparatus is submerged at the bottom of the pond, and the spent elements are arranged around the bottom of the irradiation sample can where a gamma flux of up to 3 megarads per hour may be obtained. Failure of a grease is denoted by a rise in temperature.

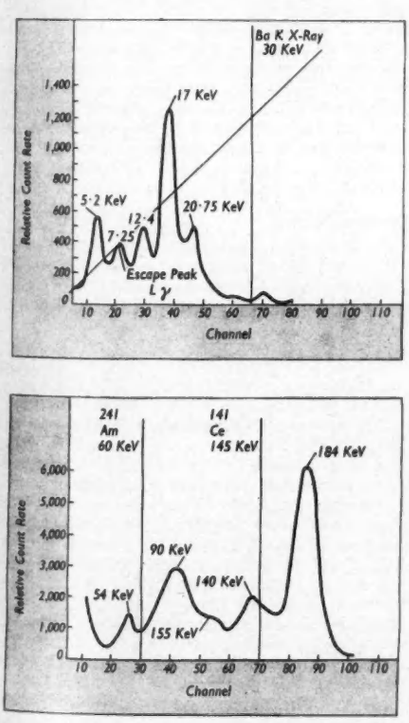


Fig. 1 Energy spectrum for plutonium 239 (top) and enriched uranium (bottom).

Radiation Pyrometer

A method is being patented by the UKAEA for the continuous measurement of surface temperatures of metal bars in the range 650 to 750° C, travelling at rates up to 20 ft per min. The heat radiation transmission path is provided by a quartz rod; the rod has two breaks, the first for a rotary radiation chopper in the form of a slotted disc turning at a speed to give a chopping frequency of 1,000 counts per second, and the second for a radiation chopper having alternate blades of perspex and germanium and giving a frequency of 10 cycles per second. The rod transmits radiation over the wavelength interval from 0 to 2·5 microns, the perspex blades of the second chopper from 0 to 2 microns, and the germanium blades from 2 to 2·5 microns. A lead-sulphide cell receives alternate signals at 10 cycles per second on a 1,000 cycles per second carrier signal. The resultant current from the cell and the two wavelength signals is recorded through suitable electronic equipment to a dial calibrated as a function of temperature.

Portable Accelerator

The 4·3 MeV linear accelerator shown in Fig's. 2 and 3 was developed by Mullard Equipment Limited to make X-ray examinations of the welding in nuclear power station pressure vessels (Atomic Review 9 Dec. '60). The accelerator measures 8 ft 9 in long by 4 ft 9 in wide by 5 ft high and weighs 2 tons. It may be rotated about the horizontal and vertical axes and may be mounted on a tower or suspended from suitable lifting tackle. The vacuum and cooling systems are incorporated in the accelerator unit and the fibreglass control cabin housing the ancillary electrical and control equipment may be sited up to 250 ft away from the accelerator.

Fig. 2 4·3 MeV linear accelerator for checking welds in nuclear reactor pressure vessels.

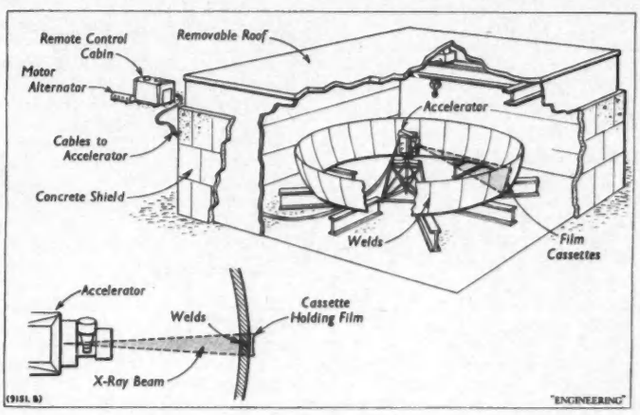


Fig. 3 Diagrammatic view of accelerator in position: 10 ft of weld can be examined from a distance of 30 ft with one exposure.

The use of a linear accelerator has the advantage of producing a small focal spot (less than 2 mm diameter), and a high energy equivalent in return for fairly small voltages. The accelerator produces, at 4·3 MeV, a radiation intensity of more than 600 röntgens a minute at a distance of 1 metre from the X-ray source.

The time required to obtain a radiograph through 4 in steel with the accelerator 1 metre from the surface of the object may be as short as 4 sec; an 8 in thickness may be radiographed in 42 sec, and 12 in in less than 9 minutes. To obtain an equivalent intensity from cobalt 60 a source of about 30,000 curies would be required. The resulting penumbra effect would reduce the radiograph definition.

Personnel Neutron Dosimeter

The description of a personnel neutron dosimeter capable of indicating the complete spectrum of the neutron dose received in addition to the dose for each neutron energy range within the spectrum is given in US Patent No. 2,938,121 by J. J. Fitzgerald and C. G. Detwiler. The device consists of three sets of indium foils supported on an aluminium case. The first set consists of three foils of indium, the second set consists of a similar set of indium foils sandwiched between layers of cadmium, and the third is similar to the second set but is sandwiched between layers of polyethylene. By analysis of all the foils the neutron spectrum and the total neutron dose of all energy levels can be ascertained.

Self Quenching Geiger-Müller Counters

The temperature effect in Geiger-Müller counters is often related to the asdorption of discharge-quenching vapours by the material of the anode and cathode for the counter. A

detailed investigation has been made of the comparative role of the adsorptions of the cathode and the anode in the temperature effect. A study was made of the temperature effect in counters of identical constructions, in which the ability of adsorption of the cathode and anode material was artificially increased. The results indicate a strong influence on the anode adsorption. Local heating of the anode, which was obtained by passing direct current through it, led to a complete restoration of the initial working characteristics of the counters during cooling of the counter. (" The Temperature Effect of Self-Quenching Geiger-Müller Counters," by A. Peeva and T. Karatoteva. From Referatirnyi Zhurnal Fizika, No. 2, 1960.)

Soil Density Measurement

Application of nuclear methods by radioisotopes for the measurement of soil moisture content and density were presented at the 63rd annual meeting of the American Society for Testing Materials. The capabilities and limitations in the use of the surface density meter were described during the pavement construction at Clinton Air Force Base. The precision of the nuclear method approached that of conventional direct sampling methods, the time of testing was greatly reduced and the cost cut by half. It appears that more investigation is required to clarify the deviation between the sand cone method and the nuclear method which have been found to exist on certain other highway projects; better results are to be expected if the instruments are calibrated for each soil type. In the AASHO road test near Ottawa, useful information was obtained using two different nuclear devices for measuring density—one developed at the AASHO Road Test and the other a commercial instrument. A nuclear surface-type moisture gauge and a rubber balloon density measuring device were also used. The investigation showed that density can be satisfactorily measured by nuclear gauges of the flat-iron type; and these would be more effective than other devices if statistical sampling and analysis were specified. The design and calibration of a neutron moisture meter, consisting of a probe using an actinium beryllium source and a scintillation type detector, were also described.

Bubble Chamber Design

A radiation sensitivity stablised 2 litre bubble chamber operating with $CBrF_3$ or fluorocarbon gas liquid mixtures is described in a report by B. Hahn *et al.* on " Controlled Sensitivity Bubble Chamber with Stabilised Final Pressure." Flat bottomed pressure pulses 30 msec long and corresponding bubble density plateaus with bubble density variations smaller than $\pm$ 5 per cent have been obtained. The chamber temperature is stabilised and the sensitivity may be reproduced at any time and can be instantaneously adjusted. Accurate bubble counting for particle velocity determinations is possible without a reference track in each bubble chamber picture. (*Nuovo Cimento* Supplement, vol. 15, No. 2, 236-45.)

Notes and News

Transatom Information Office

The European Atomic Energy Community (Euratom), the United Kingdom Atomic Energy Authority and the United States Atomic Energy Commission have established a central information office called " Transatom " (Atomic Review, 18 Nov. '60). It will function in two ways: by publishing from December 1960 onwards a *Transatom Bulletin*, which will list existing translations recently reported to Euratom and reports that are planned by various institutions and private firms. It will also establish a master file system where all data relating to translations both past and present is being assembled at Brussels. The establishment of a scientific and technical centre in the near future at Delft has required special efforts to avoid duplication between the two. The bulletin is available on a subscription basis from Transatom, 51 Rue Belliard, Brussels, Belgium, at $8 per annum or $16 by air mail.

" Atom in Camera "

A photographic exhibition organised by Ilford Limited was opened by Sir Roger Makins last December and will remain open until the middle of this month. It is devoted entirely to the peaceful uses of atomic energy and has been compiled from the extensive photographic library belonging to the United Kingdom Atomic Energy Authority. The exhibition has nine sections, and is aimed to create a strong appeal to those contemplating a career in the nuclear field. The sections vary from explaining the structure of the Atomic Energy Authority to the functions of a reactor and the individual items that make it into a working unit. There are also sectioned models of a reactor simulator and the Dounreay Fast Reactor. Remote handling equipment is available to be operated.

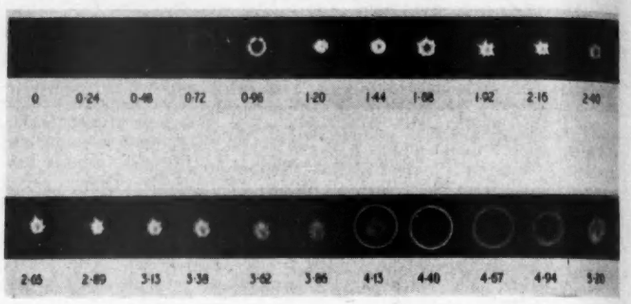


Fig. 4 High speed axial discharge photographs showing how a rapidly rising axial magnetic field compresses deuterium gas. The time, in millionths of a second, is shown below the photographs, and the exposure time is one eight-millionth of a second in each case.

Ilford Emulsions

There is a section showing Ilford emulsions used in nuclear research. These emulsions have played an indispensable part in the discovery of new particles, including the mesons, hyperons and antiprotons. The emulsions are bound sheet-upon-sheet and built up into a stack. The University of Chicago has recently sent two blocks of these emulsions, each weighing 6 cwt, up into the upper atmosphere by balloon. The emulsion is now being studied by various institutions for the effects being produced on it by cosmic rays. The emulsions are also widely used in particle accelerators, and Fig. 4 shows high speed photographs of a gas discharge in which a rapidly rising axial magnetic field is used to compress deuterium gas in a thetatron. The emulsions have also been carried by the United States " Discoverer " satellites.

Israel's Two Reactors

The Israel Government has two reactors being constructed. The first is nearly completed and will be opened during this month at Nahal Rubin, near Rehovoth, situated on the coast. The 1,000 kW swimming pool reactor is being built with the assistance of the United States government, and will be used for the production of radioisotopes and the training of scientists.

The construction of the second reactor designed to produce 24 MW(t) has begun recently, and it is hoped to be in operation in 1964. It also for the training of scientists and will be used for agricultural, industrial and medical purposes. The shortage of oil in Israel makes this country a good prospect for the early introduction of nuclear power for electrical production. Although no comment has come from the Israel authorities, the agricultural use may be for the distillation of sea water (ENGNG., 16 May '58, p. 628). A low temperature reactor is considered for distillation of sea water for drinking and irrigation purposes, a factor which has profound economic importance in an arid country.

Invitations for Steam

Invitations have been sent to about 100 cooperatively or publicly owned utility companies by the United States Atomic Energy Commission in order to find whether sufficient interest can be mustered for the construction of a 50 MW(e) organic cooled and moderated prototype power reactor. The nuclear steam supply system, including the reactor, will be financed principally by the USAEC, and the utility will provide the site and turbo-generator facilities. The plant will be operated by the participating organisation under contract with the Commission for a period between five to ten years. The utility will purchase the steam from the reactor. The steam at the turbine will be approximately 850 lb per sq. in. and 650° F. The programme is a prototype for a 300 MW(e) reactor of the same type. It is expected to operate at a power factor of about 0·8.

Increased Use of Radioactive Materials

The demand for radioactive materials is becoming more intense and in a comparatively short time since the UKAEA issued enlarged catalogues of its range of radioactive chemicals and sources, it has been necessary to issue two supplements: a catalogue of " Radioactive Chemicals " and a catalogue of " Radioactive Sources." They list, *inter alia*, eighteen new organic compounds labelled with carbon 14, and a number of new sources, which include neutron sources of new types and improved methods of construction. Promethium secondary X-ray sources and krypton 85 beta radiation sources are also listed. The supplements draw attention to the availability of two ranges of material for the calibration of radioactive measuring equipment. The first range comprises absolutely standardised solutions, whose certified activity and purity are measured to a high degree of accuracy. The second range covers reference solutions which are certified, but less accurately calibrated. From 1 January, 1961, revised charges for the irradiation of materials are based on the thermal neutron flux in which the irradiation is carried out rather than on the particular reactor.

Reactor Notes

New Voronezh Station: The first 70 MW steam turbine has been built at the Kirov Works in Kharkov. The turbine is designed to work at 29 atmospheres and 3,000 rpm. The station is rated at 420 MW.

USS Enterprise: On December 1, 1960, criticality was obtained in the first of the eight pressurised water reactors in the USS Enterprise. The sea trials are scheduled to begin this year.

High Power Density Nuclear Plant Prototype: The USAEC has signed agreements with the Consumers Power Company and the US General Electric Company for a prototype plant under the Commission's Power Demonstration Reactor Programme. The plant is being financed and constructed by the Consumers Power Company. Following the initial criticality, scheduled for September, 1962, the plant will be made available to the Commission for 4½ years for use in the research and development programme of uranium oxide fuelled boiling-water reactor cores. The initial loading will permit a power level of 50 MW(e), but this may be increased later to 75 MW. The Commission will reimburse the Consumers Power Company in connection with the research and development programme and for the first five years will waive all fuel charges.

Companies

Joy Manufacturing in the Commonwealth

MANUFACTURING in the United Kingdom, Australia, Canada and South Africa and selling its machinery in a wide variety of countries, the JOY MANUFACTURING Company, producing mining and quarrying equipment, is one of the most widely spread of United States based concerns operating in the Commonwealth.

The British subsidiary, JOY-SULLIVAN Limited has its headquarters and principal factory at Greenock, Renfrewshire. At Dronfield, in the Midlands, there are facilities for machinery repair, production and warehousing. Until two years ago Joy-Sullivan, in addition to selling the full range of the parent company's products, was concentrating on making coal mining equipment. Then in 1959 an air power division was set up. Since then valuable export business and home sales have been achieved with air compressors, rock drills and so on, produced to the designs of the parent company.

Overseas operations are carried on under the overall supervision of JOY INTERNATIONAL SA, which has European headquarters and is a wholly owned subsidiary.

The Joy companies in Canada and Mexico are separate from this set up and report directly to the Pittsburgh, Pennsylvania, headquarters. The main plant and the headquarters of JOY MANUFACTURING (CANADA) are at Galt, Ontario, near Toronto. Their output is primarily of air compressors, rock drills, slusher hoists and other products for mineral working.

Australia is described by the Joy International president, Mr. Harold J. Wheeler, as having been an excellent market for many years. The subsidiary there was outgrowing its manufacturing capacity at Sydney and a modern plant was bought to replace two smaller units. In addition to mining machinery, electrical products and Western Precipitation dust collection equipment are to be produced by the Australian company.

For the South African subsidiary, metal mining has provided the main outlet for machinery. Last year an addition to the Johannesburg plant was completed to cater for the expansion and modernisation of South African coal mines.

SCoW Implementing Fourth Development Plan

Operating on a full order book through the year, STEEL COMPANY OF WALES produced 2,777,000 tons of steel ingots, against 2,324,000 tons the year before. Steel sheet output was up to 1,113,000 tons, from 912,000 tons.

The order book for SCoW is not now quite so full as it was at this time last year, but prospects for the year are described as good. Orders up to the second quarter of the year are said to be coming along quite well.

Mr. Harald Peake, the SCoW chairman, reports that the company's third development plan, which cost £52,500,000 is now complete. The expected yearly output of 3,000,000 ingot tons by the end of 1960 was not quite attained, due to shortage of oxygen. Greater supplies of oxygen will be available in March or April and, ingot output should then increase to the full rate.

The fourth development plan, which will cost £20,000,000 should carry ingot production up to 3,650,000 tons and also provide the extra finishing equipment for processing steel sheets and tinplate. The increased output due to this scheme is expected to be available from the end of next year.

Looking to the future in ore supplies Mr. Peake reports that the trend will be to use more imported ores since the home produced ore, though cheaper has a much lower iron content and reduces the productive capacity of the blast furnaces.

If the future is to see increases in the import bill, the past year has seen an improving export record. SCoW earned £36,279,000 (an increase of £2,028,000) from its direct exports. After making the usual allowances for fixed assets replacement reserve, depreciation, interest on debentures and loans, and taxation, the profits for the year increased from the earlier year's £4,229,150 to £7,026,891.

Swift Expansion of International Computers

ICT—INTERNATIONAL COMPUTERS AND TABULATORS Limited—is emerging from the period of consolidation after the merger of its earlier form, the BRITISH TABULATING MACHINE Company with POWERS-SAMAS ACCOUNTING MACHINES Limited, which took place in 1959.

The new phase into which the company is moving is one of expanded activity with a marked emphasis on overseas markets. From £2,937,000 in the previous financial year, the group profit before interest and taxation has increased to £3,767,000 in the year ending 28 September, 1960.

Among the leading ICT advances is the 1301 computer which has now been launched on the market. It has been developed in association with the GENERAL ELECTRIC COMPANY and the joint ICT-GEC company, COMPUTER DEVELOPMENTS Limited. This is a fully transistorised computer using punched cards and magnetic tape. The 1301 is believed by the company to be of the right capacity and speed to suit the needs of a large proportion of the market for computer equipment. A substantial number of orders have already been received from customers in the United Kingdom, the Commonwealth and in Europe.

Probably no other type of industrial equipment makes quite the demands on servicing standards that are imposed by the electronic mysteries of the computer and data processing equipment in general. ICT has organised its servicing facilities in a number of categories.

The Systems Service carries out necessary studies, advisory and programme work to make certain that from a systems point of view the best use of the machines is being gained by the users. A Technical Advisory Service is at the disposal of the client to help in obtaining the greatest possible use from the machine once it has been installed. Field Engineering Service's function is to maintain the installed equipment at the fullest condition of operating efficiency and the ICT Supplies Branch is there to provide items of office supplies specially designed for use with the equipment.

ICT has subsidiary companies in Australia, New Zealand, Canada, India, Denmark, France, Western Germany, Italy, Mexico, Switzerland, Kenya, Southern Rhodesia and South Africa.

In association with RUYS' HANDELSVEREENIGING NV a new company has been founded in Holland.

Operating on the frontiers of industrial and commercial methods of management and control, ICT has to invest time and money in a considerable education programme. Almost six thousand people passed through the Computer College at Bradenham Manor, the residential schools at Cookham-on-Thames and the non-residential school in London during 1960. The engineering school at Letchworth has been doubled in size and large numbers of field engineers and apprentices attended the Letchworth school and others at Croydon and elsewhere.

Argentinian Visitor at Perkins Diesel Factory

One of the countries described in the current GEC *Export Guide* as having improving prospects for the British export trade is Argentina, a nation whose traditional trade links with the United Kingdom have shown rather more opportunity for expansion than positive achievement in recent years.

The director of industry in Argentina's Ministry of Industry, Senor Gerardo Seeber (second on the left in the

picture) has been visiting this country and during his stay toured the Peterborough headquarters of the PERKINS Group.

The Perkins executives with whom Mr. Seeber is shown examining a programme-controlled flywheel lathe, included senior managers with overseas responsibilities.

Outstanding Production in a Favourable Year

Reporting a record output and a new high level of profits, Lord Braintree, chairman of DARLINGTON AND SIMPSON ROLLING MILLS Limited, describes the trading conditions of the past financial year (up to 30 December, 1960) as the most favourable for the company for many years.

When periods of high demand have been experienced in the past they have been accompanied by extreme difficulty in obtaining adequate supplies of raw material to operate the plant at the highest efficiency. But on this occasion the supply of raw materials has proved to be sufficient.

Production for the year rose 21 per cent over the previous twelve months, to 183,810 tons, and profits increased from £367,053 to £594,010.

Lord Braintree's forward view for the company is one of "reasonable optimism." The building industry continues its high activity and the situation in the car-producing companies has not been accompanied by cuts in commercial vehicle manufacture. Darlington and Simpson are the primary suppliers of wheel rim sections for commercial vehicles.

The building industry, commercial vehicles and the needs of the National Coal Board are the principal outlet for the company's steel but constant effort to widen the market for hot and cold rolled sections is extending the number of industries where customers are found.

At the same time that greater demand has been met from the home market, exports have been increased by 63 per cent over 1959. The proportion of the total output now sent overseas has reached 10 per cent. As with other companies in the steel industry a substantial proportion of the home sales goes into products which are also eventually exported.

Brightside Engineering in India and Australia

Among the most important work completed during the past year by the BRIGHTSIDE FOUNDRY AND ENGINEERING Company, part of BRIGHTSIDE ENGINEERING HOLDINGS, was the commissioning of the 32 in blooming mill for the ISCON steelworks project at Durgapur, India. The 26 in intermediate blooming mill, part of the same contract, was delivered to Durgapur and erected.

The company has received substantial orders in the engineering division for rolling mills and steelworks auxiliary equipment, including a 32 in blooming mill and four bar mill plants, one of them to be installed in Holland.

The GRAHAM FIRTH STEEL PRODUCTS Company, with its subsidiary, METAL MOULDINGS Limited, were acquired during the year. Operating at Wallsall and Park Royal, London, these companies are engaged in cold rolling steel strip and section rolling. Both have reached record levels of sales and are operating at high capacity.

Before-tax profits for the group, excluding pre-acquisition profits, was £1,061,113, a record figure which was £218,190 above the year before.

BRIGHTSIDE HEATING AND ENGINEERING Company, taking the largest volume of orders yet booked by the firm, is largely concerned in its industrial heating activities with radiant heating in the shape of radiant panels, radiant strip and the recently introduced strip heating allied with electric lighting. Four years ago the company first introduced dual-duct heating. Among the recent or current contracts listed in his annual statement by Mr. Tom C. Firth, the Brightside chairman, are those using high-velocity techniques at English Electric House, London, the store for Lewis's in Manchester, the new dockside building for British Railways at Southampton, and Newcastle upon Tyne's new town hall.

Overseas air conditioning contracts have included hospitals in Cyprus and Kuwait and several buildings in Aden. Industrial ventilation in India and pipework in Australia have added to the export efforts of Brightside.

The Ariel Leader Motorcycle

Traditional motorcycle design was reaching a dead end when the Ariel Motor Company made an entirely fresh assessment.

THE Leader motorcycle is the result of asking "Why?" It is the product of an engineering philosophy which questions the forgotten assumptions and recognises the significance of new factors.

For Ariel it was a calculated risk. Its first impact was the more startling because British motorcycle design, although good, had been tending towards the conventional for many years prior to its introduction. And the long-lived Ariel range of four-strokes had been no exception.

In this context, "motorcycle" must not be confused with the Continent-inspired motor scooter, which is essentially different and is in any case smaller. You sit in a scooter rather than on it, and coordination between the rider and the machine is achieved by pressure on the footboard rather than by lateral knee pressure on the petrol tank. When the scooter influx was at its height, critics were declaiming our own motorcycle industry as "decadent" for not having any revolutionary designs of its own to counter the scooter invasion. Not by any stretch of imagination could this criticism be applied to the Ariel Motor Company, of Selly Oak, Birmingham, who in 1955 quietly started developing the brainchild of their general manager, which was later to be called appropriately the "Leader."

The freshness of approach that pervades the whole machine is best illustrated by reference to the frame, as shown in Fig. 3. Usually the frame of a motorcycle is simply an elaborated version of a bicycle frame consisting of thin steel tubes, lugs and engine bearer plates united by brazing, welding or bolting—resultant weight about 30 lb, dependent on size. Ariel said why not make the frame in the form of a box section beam with brackets welded to the underside to carry the engine and gearbox? The result offers greater strength, is more simple to produce, is in keeping with modern styling trends, and weighs only 13 lb.

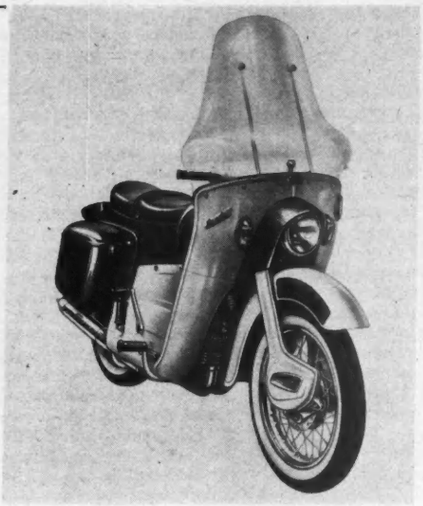


Fig. 1 One of the early Leaders.

The Leader made its debut in July, 1958. During its three years of development, Ariel had been committing money first on mock-ups and prototypes and then on new machine tools and dies, with bated breath. Would the change to a two-stroke engine prove acceptable? Would they be able to keep the machine within the £200 "target" price? Would the Leader catch on or would it be snubbed?

Two rays of hope spurred them on. The early hand-made prototype was particularly successful during its road tests, in the course of which over 150,000 miles were covered. Secondly, a very favourable reception was given by the technical press on the occasion of a preview of the new machine. To ensure that news of the project did not leak out too soon, Ariel's general manager gave a personal letter to every employee and everyone was given the chance of inspecting the prototype. The secret was well kept—it was to be their future livelihood.

In fact, the Leader was an immediate winner, although the £200 target price was slightly exceeded. So successfully did it sell from the start that within six months Ariel had decided to cease production of their previous well known range of four-stroke machines entirely and concentrate on the newcomer and its later variants. The Leader was voted *Motorcycle News* "Machine of the Year" in 1959; a mantle which passed to its younger brother, the Arrow, in 1960, with the Leader in second place.

Fig. 2 Wooden mock-up of the prototype.

In these days of rapid social and technological changes the risk of a new conception failing by being ahead of its time is far less than it used to be. Trevithick's Pen-y-Darren railway locomotive was unpopular in 1804 because it broke up the track, and steam had to wait until the Rainhill trials of 1829 before its potential for railway locomotion became generally recognised. Things happen quicker today, though the British are still conservative and, Ariel may be forgiven for a few early doubts about the Leader. The enormous capital cost of retooling alone would have daunted many a larger firm. This had to be recouped by selling a large number of machines quickly. Ariel could not afford to wait for success—it had to be immediate.

Today Ariel are conspicuous by being almost unaffected by the recession in the motor vehicle industry. While some firms are introducing short time, Ariel's factory is as busy as ever—they could still sell far more machines than they are able to produce. And except for the manufacture of spare parts for their earlier machines, they are concentrating on producing the Leader and its two later derivatives.

THE CUSTOMER

The appeal of a motorcycle is generally limited to a certain class of customer—the enthusiast. In contrast, the Leader is aimed more particularly at the man who wants a satisfactory means of transport but knows little or nothing of the finer technical points. To him comfort, style, reliability and economy are the prime factors. He is prepared to pay for quality, provided that the quality is readily apparent. But what form should the quality of a motorcycle take?

Ariel decided that, quite apart from the technical redesign, they would introduce certain of

Fig. 3 Inserting fuel tank into box section frame.

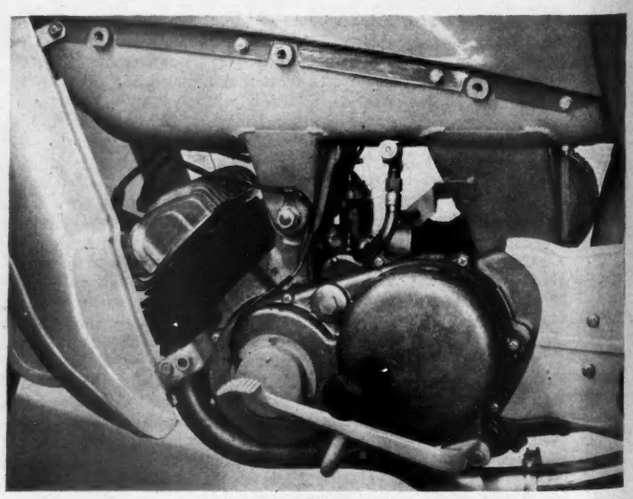
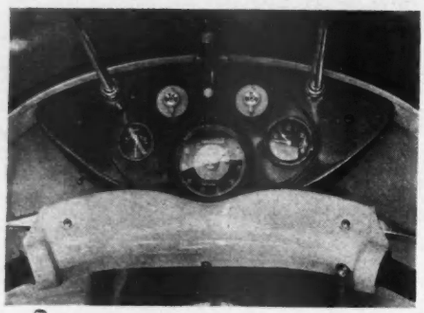


Fig. 4 Side panel removed to show engine and gearbox, early model.

Fig. 5 For new customers with new tastes: a new conception in design.

Fig. 6 (above) Pressed steel cladding sections.

Fig. 7 (below) Car type instrument panel.



the advantages of the motor car—a policy which motor-scooter manufacturers had already found popular. So the Leader was clad all over with light steel pressings to keep the rider's clothes clean. To give him the maximum weather protection, legshields and a windscreen were included as standard fitments. A car-type instrument panel of striking design was also introduced, capable of providing extensive instrumentation by the use of a few simple extra accessories. Reliability and good quality workmanship also played their part and Ariel are faced with few guarantee replacements.

Choosing the type of engine for the Leader was a particularly difficult problem. Ariel knew that to widen the customer appeal, docility at low speeds was just as important as impressive acceleration and a high maximum speed. Their 1,000 cc four-cylinder four-stroke machine, known as the Four-square, was world renowned for these characteristics but at the expense of a heavy and complicated engine. The use of a two-cylinder two-stroke was the eventual solution, This arrangement offers the same even torque characteristic, so valuable when running in towns and in dense traffic.

With the Leader, Ariel's advertisements started appearing in media outside the motorcycling press in order to reach the new type of customer.

A prime factor in the basic design of the Leader was ease of servicing, which is important to the motorcycle owner who performs his own maintenance. The beam frame permits servicing of the engine or gearbox without removing them from the machine.

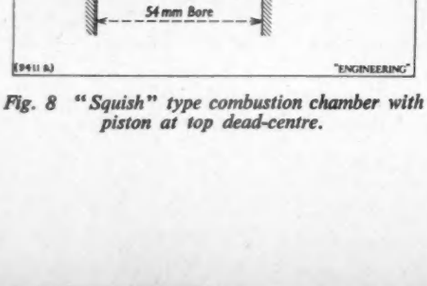


Fig. 8 "Squish" type combustion chamber with piston at top dead-centre.

SPECIAL FEATURES

Easy and accurate steering is an important feature. The trailing front fork link provides a positive "castor" action and also keeps the variation in wheelbase length with deflection of the front suspension to a minimum. The combination of beam frame and pressed steel forks provides exceptional rigidity.

The box-section frame beam is formed of two 20 swg steel pressings welded together along the centre line. Inside and outside surfaces are phosphated before painting to resist corrosion. The internal space is utilised for the fuel tank, battery, and ignition coils.

The upper shell pressing, which incorporates knee pads and looks like a petrol tank, is actually a parcel compartment. It is roomy enough for the tool-kit plus a lady's handbag or holdall; the Leader being exceptionally popular among women. The sheet cladding is formed of pressed steel sections, see Fig. 6. Those on each side of the engine are quickly removable. The deep-sided rear mudgard hinges upwards to give access to the rear wheel.

As with any modern product, styling plays an increasingly important role. The Leader's shape was the subject of critical study in its early days, a full size wooden mock-up being used to check its comfort and appearance. A two-tone colour scheme is used. Originally there were two choices of main colour, Cherokee red or Oriental blue, in combination with light Admiralty grey. While both sold very well in the south of England and abroad, there was a marked purchaser reluctance at first in the industrial Midlands and the North. Ariel therefore introduced a third and more subdued main colour, Seal grey, and this was found to be exactly what was required. Now they sell almost exactly equal numbers in the three colours.

General Data

Engine	Twin cylinder, two stroke
Bore and stroke	54 by 54 mm
Capacity	249 cc
Compression ratio	10 to 1
Engine bhp	17·5
Engine rpm	6,400
Gear ratios:	
Top	5·9
Third	7·8
Second	11·0
First	19·0
Tyre, front, white wall	Ribbed, 16 in by 3·25 in
Tyre, rear, white wall	Studded, 16 in by 3·25 in
Wheelbase	51 in
Overall length	77 in
Overall width	27 in
Weight (standard)	315 lb
Fuel tank capacity	3 gallons, reserve ½ gallon
Petrol consumption	80 mpg (at 40 mph)
Approx. maximum speed	70 mph

The range of special accessories for the Leader are indicative of the class of customer. Most significant are an electric-lamp neutral gear indicator; an eight-day clock; flashing direction indicators (anticipating legal requirements); and an inspection lamp which can be hung anywhere on the machine, and can also be used to check ignition timing.

VARIATIONS

Once a new concept has been proved basically successful, variations on it are likely to suggest themselves. Having built certain four-wheel luxury features into a two-wheel machine, the next obvious course open to Ariel was to bring out a simpler and cheaper lightweight version for the diehard motorcyclist. Accordingly the Arrow, introduced in December 1959, is a sports version of the Leader.

As can be seen from Fig. 9 it retains the latter's unique constructional features, but is different in appearance due principally to having a naked engine unit and no weather protection. The engine frame, forks and wheels are, however, identical. So much of the Arrow is produced with the same tooling as for the Leader that the selling price of both machines benefitted. The Leader is now £199 18*s* 9*d*, while the Arrow is offered at £171 17*s* 10*d*, purchase tax included. Performance is practically identical.

Fig. 9 The Arrow.

After launching the equally successful Arrow, Ariel turned their attention to technical detail improvements affecting both machines. The engine was modified by moving the sparking plugs from their original position (inclined at 25°) to the centres of the cylinder heads. At the same time the combustion chamber was reshaped to the "squish type," thus increasing the compression ratio from 8·25 : 1 to 10 : 1, and concentrating the combustion space around the sparking plug (as shown in Fig. 8). The effect on performance was to raise the maximum bhp from 16 to 17·5 at 6,400 rpm, with improvements to fuel economy and cooling.

Also the connecting rod section was altered from an I-section to an oval section, with a thickness across the minor axis of only $\frac{1}{16}$ in, to improve engine breathing. Other modifications made since the Arrow's introduction include improvements to the silencer baffles (to facilitate withdrawal for cleaning) and the front brake linkage, and increasing the tank capacity from 2½ to 3 gallons of "petroil."

For the past year or so Ariel, who are a member of the BSA group of companies, have been producing Leaders and Arrows in approximately equal numbers, and there are now over 20,000 units in service. The capacity of the works at Selly Oak is about 250 machines per week. Total employment is now nearly 500, and productivity has increased since the firm started concentrating on the new range. The increase has mainly been achieved by (1) rationalisation of parts; (2) the use of steel pressings in lieu of malleable castings and forgings; (3) greater use of non-ferrous pressure die-castings; (4) new uses found for synthetic plastics; (5) line instead of batch production; and (6) standardisation of colours. This policy has rewarded the public by permitting the Arrow to be marketed as the lowest-priced 250 cc motorcycle now made in Britain.

The original Leader concept still has a long way to go before it reaches the end of useful development. A third variation on the theme has just been announced, the "Super Sports Arrow" (or "Golden Arrow" as named by the trade press). It has a larger carburettor and an improved induction system, thus raising the bhp to 20 and the top speed to 80 mph. So the process goes on.

Apart from financial reward, Ariel have the satisfaction of knowing that they have made motorcycle history; and it would be surprising if they do not remain in the forefront of development for many years to come.

Are Modern Brakes Always Good Enough?

As car speeds have increased, so more powerful brakes have become necessary. Significant achievements have been made in the development of such brakes, but some shortcomings remain.

By Gordon Wilkins

NOTHING illustrates the difference between the American and European approach to automobile design so clearly as the brakes. In a six-page article in a leading USA car magazine on technical advances in 1961 cars, there is not one word about brakes and in a series of road tests of the new models, brake performance is not once mentioned. But it cannot be that American brakes are beyond criticism. Another road test report reveals that one 1961 model faded its brakes in one stop from 100 mph and another gave trouble at the fourth stop from 60 mph.

With the Second Reading of the Motor Vehicles (Passenger Insurance) Bill due next week, British designers have yet another reminder that they cannot afford to be content with present braking efficiencies.

The American designer produces cars for speed-limited highways where cars run at steady speeds with few sharp corners or steep gradients. Despite the very high performance potential of American cars, manufacturers do not think it necessary to pay the price for disc brakes. Several makers do offer the option of larger brakes as fitted to police cars if the buyer is willing to wait for delivery. Chevrolet offer the option of sintered metallic brake linings. Lincoln have Al-fin drums and Pontiac will supply the Kelsey-Hayes drum and wheel spider formed in a single light alloy casting at extra cost. However, brake performance is often below that expected in Europe, where narrow winding roads with many gradients impose frequent changes of speed.

For example, the 1961 Dodge D-500 is reported to have as standard equipment drum brakes 11 by 2 in giving 184 sq. in of lining area, which is substantially less than the Fiat 2100 and much inferior in effect to British disc-braked family cars. Yet this is a car powered by a 6,276 cc V8 engine developing a gross 330 bhp at 4,800 rpm and maximum torque of 460 lb-ft at 2,800 rpm. It accelerates from 0-60 mph in 6·8 sec, 0-80 in 11·9 sec, and presumably has a maximum of about 120 mph. Police-type brakes with 12 in drums can be supplied but *Motor Trend* reports that with these fade began on the second moderate stop from 100 mph.

Not surprisingly, some feeling has been aroused over a recent television programme in which it was alleged on the basis of published press road test figures that pre-war British brakes gave greater stopping power for less pedal pressure than modern brakes and argued that the pressure now needed to produce full emergency braking is beyond most women. The argument was backed up by a young lady producing 100 lb pressure on a pedal in the studio but who was unable to maintain it.

PRE-WAR COMPARISON

In fact, taking the most popular cars, it seems difficult to sustain the argument regarding increased pedal pressures and the figures give no impression of the improved quality of braking performance. Many people can remember just how horrible some of those pre-war brakes were. Depending for their effect on a powerful self-wrapping action between the shoes and the drum, they were sensitive, erratic and difficult to adjust. By grabbing fiercely they could record a high momentary stopping efficiency on a brake meter incorporating a pendulum but they pulled, snatched and faded when hot. I can only recall one pre-war car which could repeatedly and consistently be stopped in about 30 ft from 30 mph—the Lagonda Rapier. But of course this kind of stop is quite enough to send a passenger's face crashing into the windscreen At such times, the driver, aided probably by adrenalin supply, exerts far more than the normal maximum pressure on the pedal and pressure is increased by weight transfer as the drive is thrown forward when the initial braking takes effect. According to seating position and leg angle, this pressure may be 2-2¼ times the static figure, so that a woman may exert over 200 lb and a man a good deal more.

Modern drum brakes with a lower shoe factor than pre-war types are smoother and more consistent in action, while servo-assisted disc brakes will now bring heavy cars to a standstill from 100 mph in under 6 sec, giving overall retardations of about 0·9*g*. And this can be done several times in quick succession with no deterioration. It is not surprising therefore that France, Germany, Italy and Sweden are buying British brakes. Mercedes-Benz continue to use drum brakes and those on the 220 range, fitted with specially imported American linings, do give excellent results; remaining fade-free even when the nave plate on the wheel has become too hot to touch. Rudolf Uhlenhaut, of Daimler-Benz, has said that one of the reasons why they still hesitate to adopt disc brakes is a lack of definition when stopping at low speeds. Lining manufacturers argue that pads could be provided to give better stopping power in built up areas but only at the cost of heat resistance at high speeds. At all events, it seems probable that Daimler-Benz will adopt disc brakes for the replacement to the current type 300 which is expected to be a car derived from the current 220 with a light alloy V8 3 litre engine.

Certainly parking brakes on all-disc cars employing auxiliary rear callipers mechanically operated are sometimes alarmingly inefficient and would probably not pass the test now being introduced for ten-year-old cars. Jaguar have obtained some improvement on the 3·8 Mark II but the provision of a warning light to remind the driver not to drive away with the brake on seems significant.

But how much braking power is really desirable in ordinary traffic? Most modern cars provide a degree of emergency retardation which can inflict quite serious injuries on a passenger taken unawares. Designers of buses and coaches, fearful of injuries to passengers, do not allow the driver to generate more than about 0·6*g*, equal to a stop in about 54 ft from 30 mph. A stop at much more than 0·3*g* equal to about 100 ft from this speed will send the standing passengers sprawling on the floor.

Safety belts would protect car passengers but braking efficiency on public service vehicles could only be increased safely if all passengers used seat belts and standing passengers were suitably anchored. But in view of the trend to transit-type buses with an increased proportion of standing passengers for rush-hour operation, this will not be easy to arrange.

There are still some cars on which the pedal pressures for normal braking are too high and some on which fade resistance still needs improvement, but a good proportion of European car drivers now have all the braking power they can safely use. However, there is plenty of scope for development. Better parking brakes are needed for all-disc systems. It is surely time that makers of fast cars provided twin master cylinders and separate hydraulic circuits for front and rear brakes as a safeguard against sudden brake failure. Pressure-limiting valves for rear brake lines have helped to reduce rear wheel locking but there is scope for a system which distributes braking effort according to the load on front and rear wheels as is done on the DS19 Citroen. Better still would be a method of preventing the brakes locking on slippery surfaces. Probably the best achievement in this direction so far is on the experimental Ferguson car which contrives to make a single Maxaret unit serve all four wheels.

But brake design cannot be treated in isolation. It is interesting that Fiat, plagued on the early examples of the 2100 with the type of judder which sometimes afflicts cars with flexibly mounted sub frames, have given up two leading shoe brakes in favour of a type employing twin operating cylinders and centrally-guided parallel-acting shoes similar to those used by Ferrari before he switched to disc brakes.

There are many European cars which would benefit from an anti-dive front suspension of the type now widely used in the USA. By setting the pivot axes of the upper and lower wishbones at an angle to each other, upward deflection of the suspension is made to produce a rearward inclination of the kingpin which is resisted by brake torque.

SPRITE DO-IT-YOURSELF KIT

An interesting example of a do it yourself kit now available to provide a sports car with extra stopping power for racing, rallying, or even general road use, is the recently announced Lockheed disc brake conversion for Austin-Healey Sprite front wheels. It is the simplest conversion yet produced, needing only a minor modification to the existing brake master cylinder. Otherwise everything else down to the front brake hoses remains as originally on the car. Kits are obtainable from Donald Healey Motor Company or normal brake suppliers and Austin-Healey agents. An important feature of the Lockheed design is that the standard disc-type wheels can be used and it is not necessary to purchase wire wheels as has been necessary with some previous conversions. The kit includes the necessary parts for modifying the master cylinder, two discs, a pair of the latest type Lockheed PL brake calipers, and the various fixing bolts, banjo connections and gaskets. Fitting may be carried out by the Donald Healey Motor Company, any garage or by the owner himself.

The modification to the master cylinder although minor is of major importance and should not be ignored. The master cylinder fitted to the Sprite is of the integral barrel type with twin bores for brake and clutch operation, and when carrying out the conversion to disc brakes, the existing residual pressure valve body and cup in the brake master cylinder have to be replaced with new ones and an extension to the fluid tank added. This is because with no powerful brake shoe restriction springs to help the return of fluid to the storage tank it is necessary to ensure that none will be trapped in the brake lines and thus set up wear on the friction pads. There is also the point that adjustment of the pad clearances is automatic on the Lockheed disc brake; therefore as the pads wear extra fluid will be introduced into the system to compensate for it. When completed, the master cylinder will be similar to that fitted to the standard MGA 1600.

Once the minor alterations to the master cylinder have been completed all the remaining work is carried out at the front hubs. Front wheel assemblies are stripped down and the original brakes discarded.

Special discs of 8¾ in (22 cm) diameter are then bolted in place and the Lockheed calipers mounted in position trailing behind the axle. These carry easily-replaceable friction pads, the wear of which can be checked at a glance. Pads can be replaced without removing the caliper from the vehicle or even separating the two halves.

On the Shelf

By Frank H. Smith

THE first of a series of historical articles in the *Chartered Mechanical Engineer* for January ("Water-Driven Prime Movers," by Paul N. Wilson, chairman of Gilbert Gilkes and Gordon Limited) causes one to ponder on the rising interest in history in the various branches of engineering. The Royal Aeronautical Society has quite recently formed its historical section (although the aeronautical fraternity has always been that way inclined) and now with the Mechanicals tending the same way one wonders if there is not some sort of reaction to the technological rat-race that is going on between the two satellite strugglers.

I think I am justified in taking a little personal pride in announcing the re-publication by Dover (Constable, in England) of the classic *A History of the Theory of Elasticity and of the Strength of Materials*, by Todhunter and Pearson. This comes in three volumes, Volume I, Galileo to Saint-Venant, 1639-1850; and Volume II in two parts from Saint-Venant to Lord Kelvin. It has been out of print for some years and I suggested to Dover some years ago that they should re-issue it. They are in hard covers in a box-binder enabling them all to be shelved and kept together for $12·50 the set. Constable will do it soon in two volumes.

Chapman and Hall (Chapman 'n' 'All has worn a bit thin at last) have a leaflet "New and Recent Books on Technical Writing," from which I see that 1955 constitutes new or recent. That's for the Baker job on *Technical Publications* and is, as a matter of fact, the only oldie. Others mentioned are *Style Guide for Chemists*, by L. and M. Fieser (a 1960 Reinhold book), that favourite *The Technical Writer*, by Godfrey and Parr, and *Organising the Technical Conference*, a 1960 Reinhold by H. S. Kindler at 48*s*. One or two questions arise from this. *Does* one want to help people to organise conferences? Is a book on conference organisation a new and recent book on technical writing?

I get so much guff from the Microcard Foundation (901, 26th Street N.W., Washington 7), that I find a bit of difficulty in sorting it out (roll on the time when publicity material is on microcard) but you may like to know that the first decennial index to *Chemical Abstracts* 1907-16 goes on (microcard) sale 1 January, 1961. Inquiries to American Chemical Society, Special Issues Sales Department, 1155 Sixteenth Street N.W., Washington 6, DC.

Here is an addition to your library tool chest. "List of Publications on Mechanical Properties and Structural Uses of Wood and Wood Products," dated January, 1960. It is publication No. 200 of the Forest Products Laboratory, Madison 5, Wisconsin, USA. I can see no price and I do not think there is one.

"A new publication dedicated to the interests of all motor boat owners" (so kind of them to give me the opening) is *Marine Diesel News* from the PRO, F. Perkins Limited, Peterborough. Not pretentious but quite interesting if you are interested in that sort of thing.

Going back to October, the first number of *Pneutomation News* came from Lang Pneumatic Limited (Owen Road, Wolverhampton). A tract more than a journal, it deals with the firm's products and is not for the man in the street.

If you want a film about how film can help, try Rank Precision Industries at 37-41 Mortimer Street, London, W1, for their "Putting things in motion," a 15 minute 16 mm. effort.

I have had a nice letter from *Missiles and Rockets* starting "Beginning with the first issue in January 1961, *Missiles and Rockets* will be delivered to you each week by transatlantic 707 jetliner. . . ." I feel I ought to warn the pilot that if he tries any funny tricks like that round my district he'll have a traffic warden slapping a notice on his windscreen.

Lilliputian Circuitry

Proceedings of the Symposium on Microminiaturization of Electronic Assemblies, 1958. Edited by ELEANOR F. HORSEY and LAURENCE D. SHERGALIS. *Hayden Book Company, New York; Chapman and Hall, London.* (88*s*)

In 1958 the Diamond Ordnance Fuze Laboratories held a symposium on the micro-miniaturisation of electronic assemblies at which a series of twenty-one papers was read. These papers were subsequently published in the book which forms the subject of this review.

In the words of the chairman of the symposium, micro-miniaturisation means the design of twenty-one papers was read. These papers reductions of at least one order of magnitude below that obtainable with conventional sub-miniaturisation methods. It is an art which is being intensely studied under the pressure of military requirements for increasingly complex miniature electronic equipment. Its progress will be closely watched by designers of large electronic systems for civil use who will wish to take advantage of the startling space economies and other advantages that are claimed for the technique.

The symposium provided an excellent opportunity for giving engineers information in the general field of miniaturisation and the publication of the papers forms a welcome addition to the scanty literature on the subject. In the book the papers are conveniently grouped into sections, each dealing with a particular facet of the technique.

Section 1 describes the manufacturing techniques currently available and includes papers on fine line etched wiring, the use of thin films for the deposition of resistors, condensers and coils, the application of vacuum evaporation techniques to film deposition and methods of interconnecting micro-miniature electronic subassemblies. The section concludes with a survey of available automatic production equipment suitable for use in producing micro-miniature circuits.

Section 2 deals with semiconductors and, in particular, with the problem of eliminating the case of the transistor, which forms the major volume of the assembly, protecting it from parameter changes caused by the ingress of moisture and other contamination. For example, in a typical transistor, the case occupies a volume of $1{,}700 \times 10^{-6}$ cu. in but the active volume, that is the volume of the semiconductor material is only of the order of 50×10^{-6} cu. in. In this section, several methods of incorporating semiconductor material into a suitable substrate are described and the problems of stabilising the micro-miniature transistor parameters examined.

Section 3 covers the methods of manufacturing a diverse range of components and includes as the main paper one on layerised high dielectric constant capacitors. The subject list of this section shows how broad is the approach to micro-miniaturisation, for it includes papers on components such as aerials, magnetrons and indicating lamps.

The papers in section 4 (circuits) discuss the circuits available for reducing the size of the components required to achieve any given circuit function; in particular, methods of reducing the size of, or even completely eliminating, bulky bypass and blocking capacitors are suggested. Other papers deal with design procedures for a number of well known circuits such as the Nor circuit and the binary circuit. In each case the circuit behaviour is analysed in such a way as to take into account component and transistor tolerances, with the object of ensuring a reliable circuit design.

The final section is illustrated and shows how micro-miniaturisation techniques have been used to reduce the volume of typical American missile systems. The book also includes a useful survey of recent progress in the development of micro-miniaturised components and a short chapter on molecular electronics. In the latter case the circuit is fabricated as a completely solid state device in contrast to the more conventional method of building it up from a number of individual wafers, each one of which contains a distinct circuit element.

As is inevitable with a record of a symposium, the papers vary widely in their appeal and in the contribution which they make towards the advancement of the art. There are some papers which are surveys or records of progress and which will, therefore, be of greatest interest to the general reader wishing to obtain an up-to-date viewpoint. Other papers, especially those dealing with techniques, components and semiconductors, will be of value to the specialist actively engaged in the development of micro-miniature assemblies. The survey of recent progress by Lawrence Shergolis will be particularly helpful to potential users seeking information on the present state of developments. It is to be regretted, however, that little information was made available on important matters such as economics and reliability.

Each section of the book is preceded by a most useful summary of the subject matter and there is an extensive list of references, which will provide a good starting point for anyone wishing to make a more detailed study. There is a list of papers, but no general index.

There is a dearth of literature on micro-miniaturisation and publication of the proceedings of this symposium is, therefore, most welcome. It is a valuable record of the progress in the field although the book cannot of course, by its nature, be considered as a standard textbook on the subject.

R. B. STEPHENS

Tooling for a Steel Mill

Roll Pass Design. *United Steel Companies Limited, PO Box 64, Sheffield 10.* (60*s*)

Roll designers in the past worked on their own initiative, using their own experience, and reached an amazing level of good design. It is only in recent years that there has been any really good literature published in this country, most of it coming from the Continent and from America.

This book—published by the United Steel Companies—has been compiled by Mr. J. B. Orr, with Mr. James Thorburn as consultant, and with the assistance of an editorial panel comprising J. S. Armstrong, E. Bailey, E. L. Burgess and J. McLaughlan. These men are all well known in the steel industry and all are experts in their own particular field.

The first part of the book records the history of the rolling of iron and steel from the very beginning to the present day. The reader is also given a brief introduction to the theory of hot rolling and types of rolls used in the industry. The main part is concerned with roll and roll pass design, giving the background of the main basic principles used in designing rolls. In many cases it explains in detail the methods used by different roll designers in designing the rolls and roll passes for the production of various sections required by the steel industry.

It is practically impossible to impart experienc but the reader is given the principles which are followed very closely by the roll designer and mill operator; the book takes him through the various product groups, starting with the simpler

sections and finishing with the more complex and difficult ones. Each product group is treated separately.

The specific roll designs which are presented are thoroughly analysed and explained; consequently they are of particular interest to the student, who will find a difficult subject well explained with many diagrams. It could interest also the engineer engaged in mill layout. It fills the gap, that many designers and engineers have complained about in the past, for a good readable book dealing with the theory and practice of roll designing; it should be of particular interest, therefore, as a book of reference to all roll designers—difficult but never dull.

However, good as it is and welcome as it is, the book is still incomplete. It would, for example, have been interesting to have considered some of the future trends in rolling, such as that towards similar sized sections with a lighter weight per foot. These sections are more difficult to roll and to design, due to loss of temperature and difficulties in the delivery of the rolling mill, and it would have been instructive to have had the authors' thoughts on aspects such as these.

IVOR REES

Uniform Accounting for Billet and Ingot

A Guide to the Principles of Costing in the European Non-Ferrous Metals Industry. *International Wrought Non-Ferrous Metals Council, 6 Bathurst Street, London, W2.* (16*s* 6*d*)

At the present time there is very little in the way of uniform costing in the Non Ferrous Metals Industry in this country, let alone the whole of Europe. There are several methods of arriving at metal costs in producing the alloy billet or ingot from the virgin aluminium and basic metals. In some instances casting costs including metal are used in ascertaining extrusion costs, while other opinions favour billet costs or basic metal plus conversion costs.

The book endeavours to summarise existing principles of costing in use throughout Europe and differs from the normal type of costing manual. Though easily read, it is in some instances brief while in others it goes to the opposite extreme and explains at some length what may seem unnecessary to the readers for whom it has been prepared. Present methods vary considerably and while job costing might be favoured by one company, others prefer process or even output costing.

This survey has been compiled by a committee appointed by the 13 member countries of the Wrought Non-Ferrous Metals Council and is the sequel to the British Non-Ferrous Metals Federation's book *Cost Finding*, published in 1957. The task of preparation must have been monumental in view of the language difficulties, and it should be treated as a guide to those engaged in the industry and as a textbook only for the advanced student.

It is a step in the right direction towards free exchange of methods and should be of assistance to qualified accountants, particularly to those engaged in trade with Europe—more so now, with the formation of the Common Market and the European Free Trade Area.

The chapters devoted to budgetary control and standard costing are extremely sketchy and should have been enlarged as the subject is of great interest to all concerned and has great possibilities. This shortcoming is offset, however, by a bibliography to the relevant chapters which provides a fair cross-section of the many textbooks on the subject. On the other hand, marginal costing is not mentioned, whether by accident or design is not known, though here again it could be applied throughout the industry with possible advantage in export orders.

Several pages at the end of the book have been devoted to a glossary of terms giving the translation from English into French and German but with no explanation of meaning. The glossary would be better placed as the opening chapter with interpretations of meaning rather than mere translations. Further pages have been filled by a cross-index from French and German to English. There is however an adequate general index.

The book is a first attempt and no doubt after careful consideration by those concerned in the industry, the next get-together should show a marked improvement which could lead to a still franker exchange of principles.

H. A. EDEN

Paints and Coatings Classified

Practical Manual of Industrial Finishes. By B. M. LETSKY. *Chapman and Hall.* (35*s*)

The first essential of any book which claims to be a "Practical Manual of Industrial Finishes" is that the emphasis should be on practice rather than theory. Ideally it should inform the reader, in a way which he can easily understand, what types of finish (with typical formulations) are available and are likely to be available in the future; how surfaces are prepared for finishing; and what methods are available for applying such industrial finishes. The advantages and disadvantages of different finishes and techniques should be critically discussed and where specific industrial procedures are described, information on costs, time schedules and so on should be included.

The subject is admittedly a vast one, and, in his preface, the author points out that the main object of his book "is to provide a brief compact handbook for reference and immediate value to students, paint manufacturers, paint chemists, paint consumers, foremen, chargehands, application personnel, directors, engineers and works managers." How far then has he succeeded in condensing the essential information as defined above and presenting it to the type of reader for whom he has been writing? To answer this, it is necessary to consider separately the two parts into which the book has been divided, namely (1) Finishes for Wood and (2) Formulation and Application of Finishes on Metal and Other Surfaces. These are preceded by a short historical introduction but this seems of doubtful interest in such a handbook.

Wood Finishes.—In considering the formulation of wood finishes, the materials used are generally discussed in the order of their application, that is, base stain, filler, sealer or base coat, matching colour, etc. The field is generally surveyed and covers traditional as well as new materials such as cold cure ureas, polyesters, epoxide resins and polyurethane. Thirteen typical formulations are given.

At least 90 per cent of the furniture manufactured in Britain uses cellulose lacquers or sealers in the finishing process, and in dealing with the application of wood finishes the various procedures involving cellulose finishing by spray gun are described in considerable practical detail. French polishing, synthetic resin finishes for spraying and application by methods other than spraying (dipping, tumbling, roller and curtain coating) are also discussed, again from a very practical viewpoint.

The position of cellulose in the furniture finishing industry is, however, far from unassailable and the case for and against polyester finishes is presented as a separate chapter and some comparative costs given. A strong but not unanswerable case for polyesters is presented, from which it seems clear there are good grounds for a compromise between the two processes.

Having dealt with formulations and application, plant layout and schedules are given for the large-scale manufacture of the cheaper bedroom suites and radio and television cabinets. Each operation is briefly described, together with the time taken and where applicable the amount of finish consumed and floor space required.

A chapter on defects in wood finishing—their causes and cures—follows, and the section finishes with a survey of the equipment used. Here it is gratifying to see that the use, care and maintenance of the spray gun receive adequate attention.

One feels that Mr. Letsky knows his wood finishing and that what he has written is to a large extent based on his own experience. He has met the requirements laid down for a "practical manual," and if one had to introduce wood finishing into a factory, here is a book of considerable practical value to works managers, engineers, paint chemists, and foremen alike. As a reference book, however, particularly to students and chemists, it would have been greatly improved by a bibliography even if this were only a short list of recommended books and papers for further reading. As it stands there are hardly any references to literature.

Formulation and Application of Finishes on Metal and Other Surfaces.—To my way of thinking, the second part does not measure up to the standard of the first, particularly from a practical point of view. The reason could well be that the field is much more diverse. There is less specific detail (no costs, time schedules, etc.) and more general information on a wide variety of subjects. As a result it tends to be bitty. Furthermore, in one or two instances, although the general principle is right, the detail is incorrect.

It opens with a discussion of the formulation of organic finishes for metal and in 30 pages covers, among other things, surface preparation, degreasing, phosphating, etch primers, the chemical basis of polymerised coatings, finish selection, and industrial, domestic-equipment and vehicle finishes. Eighteen typical formulations are included.

Following the pattern of the first part, application methods are next considered and general information provided on such techniques as Roto-Dip; flow, roller, continuous strip, reverse roller and curtain coating; tumbling and centrifuging and the coating of cans and collapsible tubes.

But instead of continuing the theme by passing on to plant layout for metal finishing—which is dealt with nowhere near as satisfactorily as the similar section on wood—special finishes are next discussed. This chapter is a veritable pharmacopoeia, wherein are formulae, over 30

in all, for producing hammer, opalescent, crystalline, pebble, marble, pearl and flock finishes and for coating leather, hardboard, plastics and paper. Even formulae for cable and water-displacing lacquers are included.

After returning to plant layout, the final chapter deals with quality control, testing and new trends. Finally, the author returns to his favourite topic with a three-page appendix on "Polyester and Cold-cure Melamine Formulations"—for wood of course.

As a general reference handbook this easily readable well indexed book is good value for money, but a short bibliography would have added to its usefulness. Perhaps this omission will be taken care of in the second edition.

H. A. HOLDEN

Reaction Drives and Missile Fuels

Fundamentals of Rocket Propulsion. By RAYMOND E. WIECH, JR., and ROBERT F. STRAUSS. *Reinhold, New York; Chapman and Hall, London.* (44*s*)

Rocket Propellent Handbook. By BORIS KIT and DOUGLAS S. EVERED. *The Macmillan Company, New York and London.* (87*s* 6*d*)

One of the interesting things about rocket propulsion is the diversity of technologies which it involves. Chemistry, materials (both metallic and otherwise), combustion processes, heat transfer, hydraulics and thermodynamics are some of the most obvious. But what perhaps is even more significant is that rocket development often stretches our knowledge of these technologies to its very limit.

This state of affairs produces a number of side effects. For example, because new techniques are being evolved and old ones extended, progress in rocket propulsion has a lot to offer in the way of secondary benefits to other industries, some akin to rocket work, others surprisingly remote. Furthermore, work on rocket propulsion, embracing such a wide range of techniques, attracts the young engineer and provides him with much valuable training for whatever work he may subsequently do. For these reasons alone (and of course there are many others equally significant) it would seem a great pity if this country resigned from the field of advanced rocket propulsion and decided to do space research, with other people's hardware.

Quite apart from these fundamental issues, the nature of the rocket engine determines to a great extent the sort of technical books which are written about it. Broadly speaking, there are two sorts, the general treatise which endeavours to cover the whole field (inevitably rather thinly in places), and the more specialised work, which takes one particular aspect of the subject and deals with it more thoroughly. As their names imply, *Fundamentals of Rocket Propulsion* comes in the first category, while the *Rocket Propellent Handbook* comes in the second.

Fundamentals of Rocket Propulsion is intended to be an introductory book, the first of a series on space propulsion, succeeding volumes, we are informed, being more specific in their scope and technical in their presentation. Beginning right from first principles, the introductory volume under review is therefore quite suitable for the reader with limited technical knowledge and considers the design, manufacture, and development of both liquid and solid propellent engines, with concluding chapters on non-chemical rocket engines and the application of rocket propulsion in space.

The authors are engaged on rocket work and consequently the book possesses a ring of authenticity. There are copious bibliographies and a number of photographs and line diagrams are included. Although not the only book of this sort to be published, *Fundamentals of Rocket Propulsion* deserves a high rating in its class and can be recommended for those merely interested in the subject, as well as those who hope to take it up as a profession.

The *Rocket Propellent Handbook* meets quite a different requirement. In any rocket engine the choice of propellents must always be an important consideration, governed, of course, by the particular duty to be performed. Performance is not the only criterion since propellents must be manufactured, handled and stored, and if they are liquids, pumped and often used for cooling purposes. Consequently the chemical and physical data relating to all propellents are of vital importance to the rocket engineer.

The *Rocket Propellent Handbook* provides such information for about one hundred propellents or groups of propellents. Organic and inorganic chemicals are discussed including both solids and liquids, and there is a chapter on the properties of pressurising gases as well. The amount of information provided understandably varies from propellent to propellent, and, as one would expect, there are inevitable gaps, particularly with regard to the lesser known and lesser used chemicals. Generally speaking, however, a great deal of very valuable data is provided, and each chapter contains an exhaustive reference list and bibliography. This is basically a good reference book and as such will prove a most useful addition to the professional rocket engineer's library.

W. N. NEAT

New Books

The Capital Budgeting Decision. By HAROLD BIERMAN, JR., and SEYMOUR SMIDT. *The Macmillan Company, New York and London.* (42*s*)

All too often, the authors consider, costly capital expenditures are approved on the basis of intuition, rule of thumb, or faulty theory. The purpose of the present book is to present a systematic method for determining the profit potential of possible capital investments. Case studies and sample forms are included.

The War at Sea 1939-1945. By S. W. ROSKILL. Volume 3: The Offensive, Part 1. *HM Stationery Office.* (45*s*)

Captain Roskill's latest volume covers the period of the attacks on the Tirpitz and the sinking of the Scharnhorst by the Home Fleet, and the great seaborne assaults on Sicily, Salerno and Anzio.

Race for the Moon. By MARTIN CAIDIN. *William Kimber.* (36*s*)

A popular account of the American lunar probes, including eye witness descriptions of launching procedures. The Soviet programmes are also considered.

The Science of Wealth. By C. F. CARTER. *Edward Arnold.* (14*s*)

An elementary textbook in economics intended primarily for those whose only acquaintance with the subject will be a single-year subsidiary course, and particularly science and technology students who wish to get a general picture of the workings of the industrial and business world which will support their work.

Symposium on Air Pollution Control, San Francisco, 16 October, 1959. ASTM Special Technical Publication No. 281. *American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.* ($1·50, *members* $1·20)

Five papers from the symposium, dealing with determination of atmospheric inorganic fluorides, colorimetric determination of formaldehyde and methanol, fluorescent dyes as airborne tracers, climatic factors on the California coast, and the use of wind and weather summaries in chemical plant design.

Mess- und Regeltechnik. Dechema-Monographien, Band 35. *Pulbished for the Deutsche Gesellschaft für Chemisches Apparatewesen by Verlag Chemie, Weinheim/Bergstrasse.* (31·50 *DM*)

A series of lectures on control theory and practice applied to chemical and process engineering.

Festschrift Richard Grammel, zum 70. Geburtstag am 3. März 1959. Edited by K. von Sanden. Ingenieur-Archiv, 28. *Springer-Verlag, Heidelberger Platz 3, Berlin-Wilmersdorf.* (52 *DM*)

A celebratory volume for Herr Grammel's 70th birthday, made up of contributions from his pupils, who write from academic and research addresses all over Europe and North America.

World Railways, 1960. 6th Edition. Edited by HENRY SAMPSON. *Sampson, Low, Marston and Company.* (105*s*)

The welcome new edition of *World Railways* covers over 1,500 railways in 108 different countries. Vast development programmes are reported from China and the USSR, and from many countries come details of new methods in freight handling.

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Overhead Line Alarm. THOS. W. WARD LTD., Albion Works, Sheffield. Forward "electro-alarm" system for giving indication to crane drivers of the approach of overhead power lines. Leaflet, ill.

Mobile Crane. BRITISH HOIST AND ROPE CO. LTD., Compton, Berks. "Iron Fairy" all hydraulic 6 ton crane; 17 ft outreach. Brochure, 8 pp., ill.

Hydraulic Rams. E. P. BARRUS (CONCESSIONAIRES) LTD., Acton, London, W3. Blackhawk Porto-power hydraulic rams and ancillary equipment for all purposes. Brochure, 12 pp., ill.

Crawler Mounted Cranes. NCK-RAPIER LTD., 32 Victoria Street, London, SW1. Crawler mounted cranes various capacities up to 62 tons. Range given in 8 p. ill brochure and individual models in separate brochures. 12 pp., ill.

Prefabricated Buildings. J. E. LESSER AND SONS LTD., Green Lane, Hounslow, Middx. Middlesex flat roof buildings described and illustrated in leaflet.

Line Marker. EXPANDITE LTD., Chase Road, London, NW10. Machine for applying thermoplastic line markings to roads; heated by liquefied petroleum gas. Illustrated leaflet.

The Reviewers

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Marketing

Ruston Contracts in the New Hebrides

RUSTON AND HORNSBY, of Lincoln, and their associates, PAXMAN, of Colchester, are to supply all the diesel power equipment for a new manganese mine now in an advanced stage of completion in the South Pacific islands, the New Hebrides.

The equipment, worth more than £80,000, is being installed at Forari, a remote area on the island of Efaté, where the COMPAGNIE FRANÇAISES DE PHOSPHATES DE L'OCEANIE is developing the exploitation of substantial manganese deposits.

Open cast mining will employ two Ruston-Bucyrus excavators which are to load the material into lorries for transport to a washing and treatment plant. From the plant the manganese will be loaded direct into the holds of ocean-going vessels.

Five Ruston 340 bhp engines have been installed to drive 250 kVA generators for the treatment plant, the workshops, port facilities, pumping station and the workers' domestic needs.

Engines are also being supplied for the launches and tugs employed in the harbour now being built. These will be two Ruston 48 bhp units for the harbour launches and two Paxman 150 bhp engines for harbour tugs.

Insufficient Recovery in Shipyard Orders

Total orders booked by British shipyards in 1960 have increased by more than 300,000 tons over 1959. New orders for the past three years have been for 144 ships of 497,000 tons in 1958; 198 ships of 319,000 tons in 1959 and for 248 ships of 627,000 tons last year. In the last quarter of 1960, 72 ships were newly ordered and they amounted to 210,000 tons gross.

This was not a rate of new ordering sufficient to prevent the industry's total order book contracting and there was an additional retrograde movement in the cancellation during 1960 of orders for 20 ships of 165,000 tons.

At the close of the year the overall order book stood at 440 ships of 3,348,000 tons with an estimated current value of £500 million. Just over 560,000 tons of this total (52 ships) is for foreign owners. The precarious position of shipbuilding concerns is best seen by the alarming relationship between the amount of tonnage already laid down and the total volume of orders.

Of the 3·3 million tons on order 1·6 million is laid down, and of the remaining 1·7 million some is not for delivery before 1965-66 and other ships have had their construction held up until the prospect of higher earnings from shipping are brighter.

Keel laying is one of the key indicators of the industry and 1960's total of less than a million tons gross laid down was 150,000 tons below the level of 1959, almost 300,000 tons down on 1958 and over 500,000 tons less than in 1957.

The declining value of orders underlays much of the gloom on the industry's immediate outlook. From the beginning of 1958 the shipyards have built more than 4 million tons of shipping, seen some 850,000 tons cancelled and added only a year's output—1·4 million tons—in new orders. The result has been a fall in the order book of more than 3 million tons.

The table of orders received and the total order book shows how the recovery in orders has been insufficient to do more than slow down the fall in total orders.

Delivery Dates and Proper Packing

Criticisms of industry getting a bad name by inattention to keeping delivery dates is not new, but the amount of attention now being given to the problem suggests that higher priority is being given, at least in a number of firms, to correcting the position.

Mr. Peter Tennant, the overseas director of the FEDERATION OF BRITISH INDUSTRIES, said at a recent meeting on exports of the AGRICULTURAL ENGINEERS ASSOCIATION, that people do not mind long deliveries so long as the promised dates are kept. A lot of time had now to be spent "clearing up the mess" because, in Mr. Tennant's opinion, it was getting us a bad reputation.

The export clubs that have been formed and the export round-table meetings that have taken place have done useful work with problems of finance, transport, agents and production being discussed and with much mutually useful brain-picking.

At last week's introduction of the current issue of the quarterly *Export Guide* put out by the GENERAL ELECTRIC COMPANY, GEC's chairman, Mr. Arnold Lindley, dealt an effective blow to the convenient idea that executives can get a useful picture of what is going on, and what is wanted from manufacturers, from a fleeting visit overseas.

"People do not go overseas for long enough," said Mr. Lindley. "They go for two or three weeks, do the usual round of cocktail parties and they think they have seen a cross-section of people."

The GEC chairman, who was an engineer and a principal executive in South Africa for many years and an adviser to the South African Government, does not think that it is possible to get to know an overseas market in less than two or three years.

On overseas deliveries he is concerned not only with the "when" but also with the "how." There has been not only insufficient knowledge about packing but even on occasions not enough packing for the arrival of the goods in their proper condition.

But when all this is tidied up it will still need, as Mr. Lindley sees it, a solution to the shortage of investment capital in the developing nations before the decline in heavy equipment export orders is turned into an upward moving line on the sales charts.

In terms of one nation alone, this brings us back to the familiar dilemma that until Great Britain earns a surplus on the balance of payments on something like the scale of Western Germany, we shall not have the money to lend in large enough amounts, or on long enough repayment terms.

Fiftieth Blast Furnace in Thirty Years

ASHMORE, BENSON, PEASE and Company, a member of the DAVY-ASHMORE Group, reach their fiftieth modern blast furnace to be constructed in the United Kingdom and abroad in the last 30 years with the order for a new 20 ft hearth diameter furnace for the FORD MOTOR Company, Dagenham.

By a coincidence it was the Ford Company that ordered the first blast furnace from Ashmore before the First World War. That first furnace had a hearth diameter of 18 ft 3 in and set up records for output in Britain which it retained unbroken for 12 years.

Ford's new furnace is to go into production in the summer of 1962.

BEA Passengers Up Profits Down

Some idea of the excess capacity problem of a major modern airline is given by the BRITISH EUROPEAN AIRWAY's statement that during 1960 the Corporation made almost 230 million capacity ton-miles available and sold 66 per cent of them.

Just over 20 per cent more passengers, 3,866,000, were carried during the year than in 1959 but the estimated profit declined from £2 million in 1959 to £1½ million. This result is described by the BEA chairman, Lord Douglas of Kirtleside, as "not unsatisfactory" in the circumstances.

Lower fares reduced the average revenue rate by about 5 per cent, the delay in Vanguard deliveries cost a large amount and there were the additional costs in introducing the Comet.

In an expensive and difficult year the cost of each capacity ton-mile produced was held at the 1959 level.

Lord Douglas presents a livelier picture of Gatwick airport than some earlier commentators. He points out that during last September the airport handled more passengers than Edinburgh and Belfast together. Over the summer months Gatwick came fourth, behind London Airport, Jersey and Manchester.

Gatwick's main problem for the future, as with the whole of BEA's economics, is going to be the extremely seasonal nature of European air traffic, with its overwhelming emphasis on holiday journeys.

German Car Industry's Activity Undiminished

Free from the depression that has troubled the vehicle industries of her competitors, Western Germany last year increased her output of cars and estate cars by 300,000—from 1,503,424 in 1959 to 1,816,771.

Including commercial vehicles the total production passed two million for the first time. The overall figure was 2,055,142. From this grand total almost a million (982,819) were exported, compared with 870,957 sent abroad in the previous year. While the number of vehicles exported rose, the proportion of the year's output sent overseas fell slightly, from 50·7 per cent in the preceding twelve months to 47·8 per cent.

The statistics issued by the West German Association of the Motor Industry show that there may be something of a move towards more seasonal home buying in the home market, a move which is being watched for with close attention.

South African Exports at New High Level

Despite foreign trade boycotts, South Africa last year exported £724 million worth of goods (including £286 earnings from gold). The new, record level of exports is approaching double the value of goods sent overseas ten years ago. The equivalent figure in 1950 was £397 million.

Although South Africa's foreign trading gives her a significant balance of payments on the credit side, the withdrawal of capital by overseas investors who either disapprove the Government's racial policy or fear its consequences has been on such a scale that 1960's loss of capital amounted to £115 million. The result has been Government restrictions on imports in an attempt to correct the unbalance.

Round the Clock Production for Nu-Swift

From last Monday, NU-SWIFT Limited, the fire extinguisher makers, have been on three-shift working at their Elland, Yorkshire, factory.

The heavy flow of new orders has been brought on by the Factories Act, 1959, Section 12(1) which from 1 December last year made the installation of fire extinguishers compulsory in all factories.

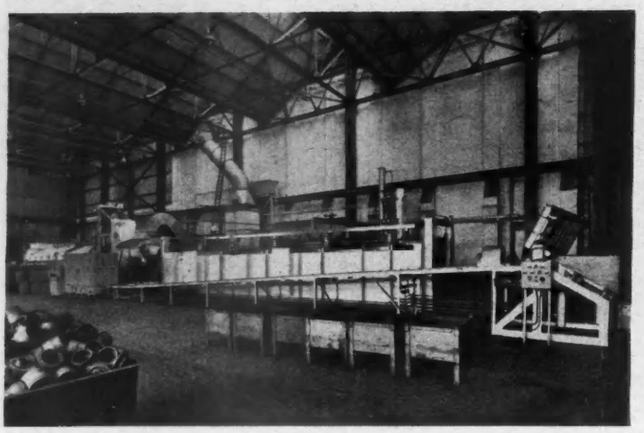
Nu-Swift intend, by raising the level of output, to continue meeting their orders from stock.

Order placed with British Shipyards

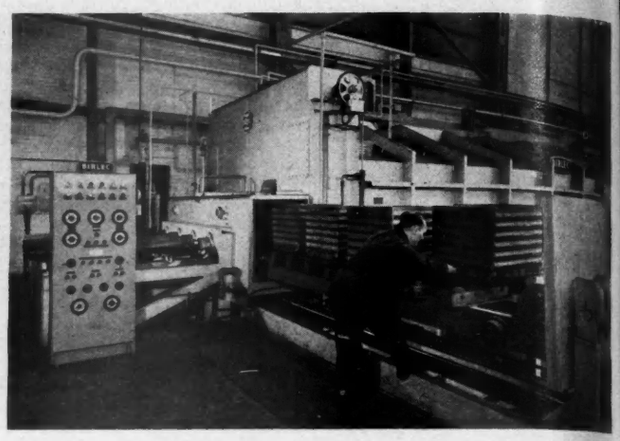
	New Orders Received 12 Months to December			*Total Order Book*	
	Ships	*Tons gross*		*Ships*	*Tons gross*
1960	248	627,000	31 Dec. '60	440	3,348,000
1959	198	319,000	31 Dec. '59	498	4,169,000
1958	144	497,000	31 Dec. '58	611	5,430,000
1957	258	1,679,000	31 Dec. '57	812	6,828,000
1956	365	2,475,000	31 Dec. '56	865	6,442,000

BEA Traffic and Staff Figures, 1960
(Provisional estimates)

	Year ended 31 December, 1960	Year ended 31 December, 1959	Variation per cent
Capacity ton-miles offered	228,500,000	189,325,000	+ 20·7
Load ton-miles sold	151,500,000	126,444,000	+ 19·8
Revenue load factor	66·3 per cent	66·8 per cent	− 0·8
Passengers carried	3,866,000	3,206,684	+ 20·6
Passenger miles flown	1,352,000,000	1,130,514,000	+ 19·6
Passenger load factor	67·5 per cent	68·6 per cent	− 1·6
Freight ton-miles	16,590,000	13,852,100	+ 19·8
Mail ton-miles	4,180,000	4,009,800	+ 4·2
Average number of employees	12,900	11,989	+ 7·6
CTM per employee	17,700	15,792	+ 12·1



The furnace installation seen from the discharge end with the low temperature furnace on the right.



The charge end of the high temperature furnace of the multi-track furnace installation.

How to Anneal for Quality and Economy

An annealing plant used in the production of pearlitic malleable castings keeps labour costs down, and produces a high quality product.

THE use of pearlitic blackheart malleable castings in the automobile and allied industries in this country is growing and as a result Ley's Malleable Castings Company Limited, who have been making their "Lepaz" pearlitic malleable for 30 years, decided some time ago that additional capacity was required. Accordingly, AEI-Birlec was commissioned to build continuous equipment with a minimum capacity of 150 tons per week for Ley's new annealing department. It was emphasised that the quality of product was essential and that design and construction must ensure that the plant should run with only routine maintenance from one summer holiday to the next. Moreover, automatic operation was to be adopted to ensure consistency of product and to reduce labour costs to a minimum.

It should be noted that, while batch furnaces can be used for the annealing of pearlitic material, the very fast and uniform cooling required after the high temperature part of the annealing cycle to provide high quality can only be obtained by handling in comparatively small quantities in a continuous plant.

The plant is designed for the scale free annealing of pearlitic castings at a rate of 1 ton per hour. This is achieved by charging together into the high temperature furnace four trays per hour, each holding about 5 cwt of castings. These trays are discharged individually, one every 15 minutes, for the castings to be cooled and then progressed through the low temperature furnace.

The time/temperature cycle used is as follows: heat to 950° C in 4 hours; hold at 950° C for 15 hours; cool to 650° C in less than 5 minutes; reheat to 700° C; hold at 700° C for 4½ hours; and cool to handling temperature.

The plant comprises a furnace for the high temperature part of the cycle, followed by a charge dumper and air blast cooling conveyor and finally a low temperature furnace with cooling station and tray discharge gear. Conveyors are included for returning the trays to the charging areas.

The furnaces are of the pusher tray design with hydraulic operation and automatic sequencing throughout; the complete plant being operated by two men with occasional supervision by the heat treatment superintendent and laboratory personnel.

The high temperature furnace has four tracks and is equipped with lock chambers to ensure that the atmosphere in the main chamber is substantially undisturbed during charging and discharging. The charge end lock chamber is designed to accommodate a charging car entering from one side and which accommodates four trays. It also houses the four pusher heads, which, by means of hydraulic cylinders, progress the lines of trays through the furnace. A vertically rising door communicates with the main chamber. The discharge lock chamber is on similar lines, with skid rails on to which the trays are pushed from the furnace. Trays are discharged, one at a time, by a cross pusher into a discharge vestibule, from which another pusher projects them on to the dumper table. The necessary doors are operated in sequence with the other movements.

The furnace is electrically heated in four zones with a total rating of approximately 600 kW, nickel-chromium tape elements being used in the roof and Birlec cast grid nickel-chromium elements in the hearth, the latter to resist failure due to build up of foreign matter.

The dumper table is lifted hydraulically complete with tray, the action being such that the tray is tilted to an angle for discharge of its contents on to the cooling conveyor. After cooling has been carried out, the table returns to its normal position automatically and the empty tray is passed on to the return conveyor and finally into position for recharging.

COOLING CONVEYORS

The cooling conveyor is an inclined unit of the vibrating type. It is fitted in a chamber which forms a duct along its length, with air blown on to the underside by a fan, the hot air being discharged upwards. After cooling to below a chosen temperature, the castings are passed by the conveyor to a tray of larger size than those used in the high temperature furnace ready to go into the low temperature furnace. The use of the large tray avoids the trouble of repacking by hand.

The low temperature furnace takes a single row of trays; a hydraulic pusher situated under the cooling conveyor being used to convey them through it. The furnace is an electrically heated unit rated at 290 kW, in three zones and fitted with fans to ensure the correct heating conditions. The heating elements are of nickel-chromium tape on the side walls and partly on the roof. Doors are fitted, the one at the charge end being hydraulically operated in sequence with the other operations. The discharge door is left permanently open and is only fitted for use during heating up the furnace after a shut-down period.

Across the charge end of the furnace there is a section of conveyor, extending from the tray return conveyor. In it there are three tray positions in front of the furnace. The first of these is a "tray ready" position into which the operator pushes an empty tray ready for it to be transferred later to the "loading" position. In the latter, an empty tray receives a charge from the cooling conveyor automatically and is then passed into the furnace as indicated earlier. The third position is used for final cooling off of a tray of castings if other than the normal low temperature treatment is to be given, for example, when reheating for oil quenching.

Cooling of the castings for handling is obtained by means of an air blast as each tray emerges from the furnace. There is an elevator table to receive each individual tray. At its upper position, this table is inclined sufficiently to allow free gravity discharge via a fixed inclined roller track on to a discharge dumper. This dumper discharges the castings into the skip used to take them to the next process and later deposits the tray on the return conveyor which is inclined to take trays back to the charging end of the low temperature furnace by gravity.

A 2,000 cu. ft per hr nitrogen generator has been supplied to provide atmosphere for purging the lock chambers after the charging and discharging operations and to ensure that the atmosphere established in the high temperature furnace is substantially unaffected throughout the heating and soaking period in this furnace. This is most important as it is desired to ensure that decarbonisation is kept to a very low figure in the endeavour to obtain good quality.

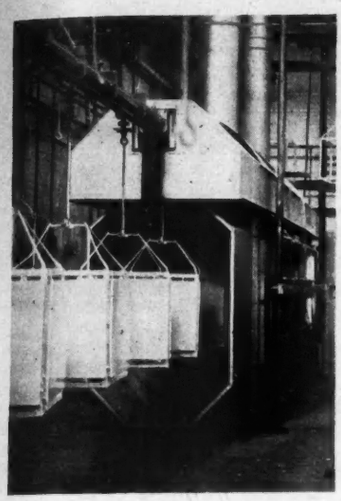
The plant includes a storage vessel for 2 hours supply of gas to enable routine maintenance to be carried out without impairing operation of the furnace and to provide the short-time high rate of flow for purging the lock chambers.

The usual system of control for power and auxiliary circuits and for temperature has been adopted. The electrical equipment is fully interlocked and incorporates all necessary safety features. The temperature control and recording instruments are accommodated in a very well arranged control room which also contains the controls for the elevator batch furnaces supplied by AEI-Birlec some years ago. The oil hydraulic pumping and control equipment is contained in a cabinet alongside the furnace and the main operating controls with sequence switch and timers are in a cubicle at the charge end of the high temperature furnace. Warning devices as necessary to keep the operators informed are incorporated.

The equipment has now been operating under normal production conditions for almost a year and it is already clear that the chief aims have been realised, both so far as quality of product as well as reliability of service are concerned.

Gas Fired Stoving Plant

Underlining a trend for manufacturers to use gas fired radiant heat stoving equipment is an installation recently completed by Parkinson Cowan Industrial Products at AEI-Hotpoint, Peterborough. Until two years ago, the stoving of washing machines and refrigerators in the Peterborough plant was handled by two electric ovens. Demand for AEI-Hotpoint appliances increased and to cater for the stepped-up production, Parkinson Cowan's installed two 15 ft gas fired radiant heat ovens.



One of the two 15 ft ovens.

With the introduction of the Iced Diamond refrigerator, production was again stepped up at Peterborough and the factory premises were extended. Two further Parkinson Cowan ovens were then installed with conveyors, water spray booths and electrostatic spraying units. The two ovens involved in this second installation were a primer coat stoving oven, 72 ft long, consisting of 144 panel units operating at 600° F, and a finishing coat stoving oven, 66 ft long, consisting of 132 panel units operating at 450° F.

As a result of experience gained from the operation of the first two gas fired radiant heat equipments AEI-Hotpoint recently decided to install yet another gas fired infra-red oven. Parkinson Cowan again designed the plant in cooperation with the users and manufactured the ovens. Installation work on the new ovens, both 27 ft long and consisting of 54 panel units, was performed during a holiday period so that production was not interrupted.

Weighing Materials on Conveyor Belts

The electronics division of Murphy Radio Limited of Welwyn Garden City have received Board of Trade approval for a new electronic system for the continuous weighing of belt conveyed solids. This is the first electronic pattern for inventory weighing to receive such approval. Transweigh, as the system is called, should have a wide application. The patent employed in the system is based on a short weighing carriage employing a resistance type load cell which senses the weight of material on the conveyor belt. Belt speed can be measured by a selsyn system or by a tacho-generator, depending on the application.

Belt weighers can be supplied to measure full scale loads in ranges from ten to thousands of tons per hour. Belt load and belt speed are continually integrated and the accumulated load presented in digital form to a Veeder Root counter. A measuring unit houses the counter and, in addition, an instantaneous rate of flow meter. This unit has been especially developed to weigh fluctuating loads accurately, and it may be mounted any distance from the weighing carriage.

The very small dc signal from the load cell is fed into a potentiometric servo-amplifier, which positions the ball on the disc of a ball and disc integrator housed in the measuring unit. Belt speed is transmitted to the disc by a selsyn system, and these two variables are thus continuously integrated.

By resetting a potentiometer in the measuring instrument, the ball position (proportional to belt load) can be reset to zero-out the day to day variation in belt weight due to adhesion of material to the belt and change in belt "tare" weight due to moisture. By integration through zero (traverse of the ball through the disc centre) variation of belt weight along its length can be averaged out.

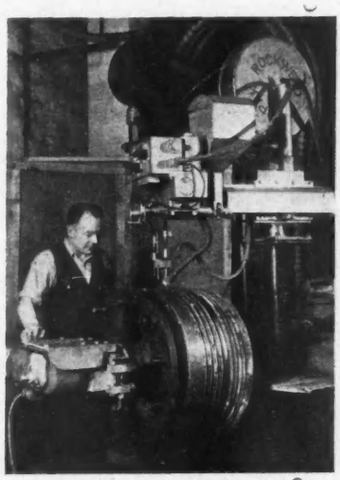
A true rate of flow signal can be produced by energising the load cell from a tacho-generator. This signal can be fed to conventional instrumentation to provide many types of automatic control—feeding materials at preset rates, delivery batching to predetermined quantities, and blending materials in preset ratios.

Automatic Welding of Pistons

An interesting example of the use of automatic arc welding equipment has been put into practice at the Sheffield factory of Lockwood and Carlisle Limited, marine engine piston ring specialists. The application concerns the renovation of complete steel piston heads of marine engines. When these heads arrive at the factory, the wear on the grooves is extremely severe. These grooves are first cleaned out in order to take a range of widths of wearing rings. (The rings are in halves, with overlapping L-joints.)

The rings are then welded in place using Rockweld Limited's Autopak arc welding equipment. Finally, the grooves are machined to the manufacturers' standard width and then ground. This service can be carried out on pistons from 560 mm diameter up to those of the largest marine diesel engines in use.

The Autopak equipment is used in preference to hand welding, because it gives a continuous weld. It is also, of course, much quicker. The machine can be operated by one man alone in this application and the welding current is generally about 390 A.



Welding piston heads.

In designing the Autopak the makers concentrated upon devising a system of control which would afford improved sensitivity with respect to other known methods; and upon producing a machine primarily for the fabrication shop, with emphasis on versatility, robustness, simplicity of maintenance, and freedom from those elaborations which add unnecessarily to cost.

Packaging Computers for Export

The rapid development of electronics in recent years has necessitated parallel progress in export packaging techniques. This is especially true in the case of very expensive equipment; for mass produced goods intended for general sale some firms seem to prefer cheap packaging methods and if a small number of the goods arrive damaged they are still happy. If, however, a computer worth £100,000 or more is to be flown or shipped abroad, it is not surprising that the makers should decide to take some care in the packaging.

This was the problem that faced Elliott Brothers (London) Limited when, less than two years ago, they began receiving export orders for the National-Elliott range of computing, process control and data processing equipment.

After investigating the situation, Elliotts went to Hairlok Laboratories Limited of Chiswick, London, a subsidiary of the Hairlok Company Limited who are manufacturers of rubberised hair and latex foam. This company founded a research organisation in 1956 to devise and test the most effective methods of using their cushioning materials for packaging.

Cushioned crate frames being assembled round a £100,000 line printer destined for Australia.

From the recorded results of drop tests made with comparable equipment to that being exported by Elliott's, Hairlok's were able to calculate the degree of protection that would be required for each packing case. Some computer parts required protection at levels as low as 10*g*. Hairloks's first contract was to pack a National-Elliott 405 computer, and since then they have been called in to plan and supervise the packaging of every computer of this make sent abroad.

It may take several weeks to prepare a detailed packaging specification. A typical example was a folder containing 30 closely types pages of instructions, materials, etc., for packaging a National-Elliott E32X line printer. This particular schedule contained 29 individual specifications for power units, dual motor alternator, modified film mechanism, thyratron and control cabinets, control panels, the printer itself and a great number of associated electronic units. For packing the dual motor alternator alone, 28 instructions for consecutive tasks had to be detailed and a list made of the 25 different materials required.

This insistence on attention to detail has been proved very worthwhile. Elliott's have not had a single claim for damage since they started exporting computers.

Ducted Fan Engine Cuts Fuel and Noise

Two future British aircraft, the Hawker Siddeley Avro 771 and the British Aircraft Corporation type 107, will each be powered by a ducted fan engine. Developed by Bristol Siddeley, this engine has an unusually high by-pass ratio.

THE Bristol Siddeley ducted fan engine type BS 75 is unusually interesting in several ways. To begin with, it is the first offspring of the two-year-old union between Armstrong Siddeley Motors and Bristol Aero-Engines, which formed the Bristol Siddeley Engine company. Both constituent companies had some 40 years previous experience in the manufacture of aero-engines and the merger created an industrial giant able to compete on equal terms with any engine manufacturer in the world.

The second point of interest is that the BS 75 and the BS 53 are the first high by-pass ratio ducted fan engines to be designed as such from the start. Fan engines with high by-pass ratios have been produced in America by the modification of existing turbojets and completely new engines with low by-pass ratio have been developed in Britain; but the two new Bristol Siddeley types are the first to exploit the by-pass principle to the limit set by the current state of the art.

The BS 75 is the result of an investigation, which was begun at Bristol toward the end of 1956, into the type and size of engine that would be required for the next generation of medium and short haul airliners. It was related particularly to the Hunting type 107 (now the BAC type 107) and led to the choice of a ducted fan cycle with the high by-pass ratio of 1·75 to 1 and a thrust of 7,000 to 8,000 lb.

A close check on the activities of many of the aircraft manufacturers of the free world confirmed Bristol Siddeley's ideas and made it possible for them to finalise the basic design as long ago as September, 1959. As a result of their early start, Bristol are now well ahead with their development programme.

TWO SCHOOLS OF THOUGHT

The reasoning behind the choice of a by-pass ratio as high as 1·75 to 1 is of particular interest at the moment, while two opposed schools of thought exist—one for high ratios and the other for low ratios.

The effect of by-pass ratio on specific fuel consumption at various turbine entry temperatures is shown by the curves in Fig. 3. These indicate that specific fuel consumption falls with reductions in turbine entry temperature, at any rate between fairly wide limits, and to an even greater extent with increase in by-pass ratio. However, the low temperature, high by-pass ratio engine requires a larger mass flow to produce a given thrust and, therefore, will have a larger overall diameter than the equivalent turbojet. The effect of this increase in diameter on nacelle drag and engine weight is discussed below.

Summarising the conclusions to be drawn from Fig. 3, both the "cool" turbojet and the low by-pass ratio engine have a specific fuel consumption about 8 per cent better than that of the conventional turbojet, while the high by-pass ratio ducted fan affords a further improvement of about ten per cent, at the cost of some further increase in the size and weight.

The curves in Fig. 3 are drawn for a typical high altitude, high speed cruise condition. It is

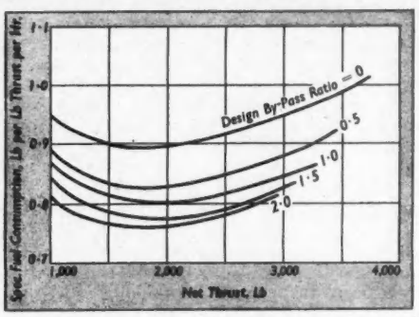


Fig. 1 Effect of changes in bypass ratio on fuel consumption.

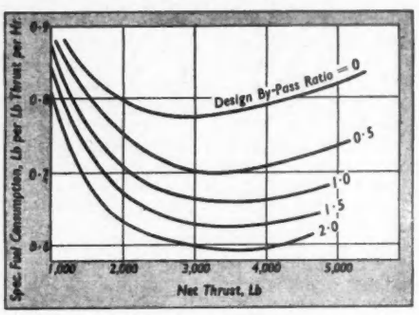


Fig. 2 Effect of changes in bypass ratio on fuel at a typical hold position.

equally important to study other flight conditions and Fig. 1 illustrates the way in which the advantage in fuel consumption of the high by-pass ratio ducted fan engine is maintained at lower altitudes. The effect of operating at reduced thrust as, for example, during a hold at 5,000 ft is shown in Fig. 2. Again the advantage of the high by-pass ratio engine appears to be maintained.

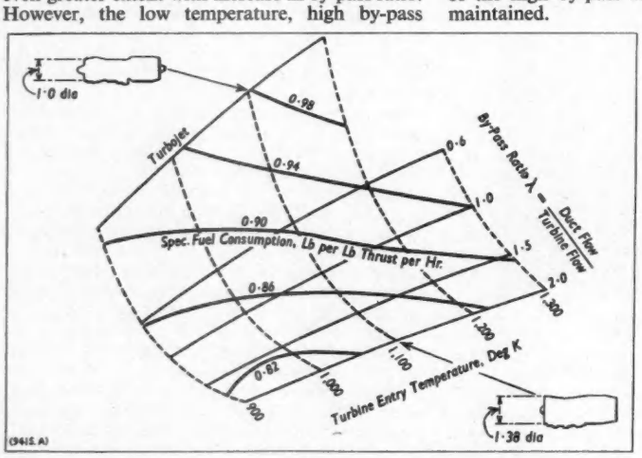


Fig. 3 (left) Effects of changes in turbine entry temperature and bypass ratio on fuel consumption of turbojet, and changes in bypass ratio on engine diameter.

Fig. 4 (right) Variation of engine-plus-fuel weight with changes in bypass ratio.

The conclusion that might be drawn from these graphs is that the high by-pass ratio is the most effective method of securing a low specific fuel consumption. It remains to be considered then, what disadvantages are associated with a high by-pass ratio and to what extent they offset its apparent superiority in fuel economy.

The increase in size with an increase in by-pass ratio has been mentioned above. Pod drag rather than engine diameter is the critical factor and this does not increase directly with engine frontal area. Bristol Siddeley say that they have made use of the best data available in both Britain and America and have designed a range of NACA type cowlings from which drag estimates have been made. By this means it has been found that the ten per cent advantage in fuel consumption of the high by-pass ratio ducted fan engine over the cool turbojet or the low by-pass ratio engine is reduced to eight per cent when full account is taken of the additional drag caused by the greater diameter of the high by-pass ratio engine. These results are said to have been substantiated by data obtained at the National Gas Turbine Establishment, Pyestock, Hampshire, and the National Aeronautics and Space Administration of the USA.

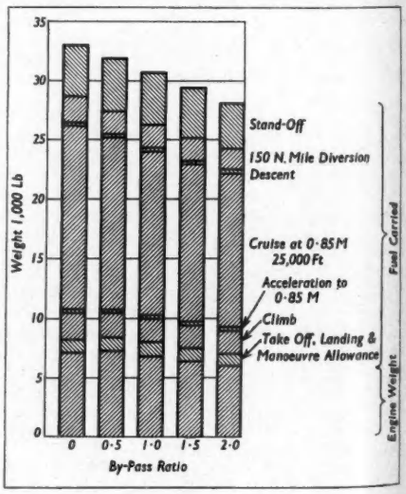
The engine weight problem is complex and, to clarify it, Bristol Siddeley designed a range of ducted fan engines of differing by-pass ratios and calculated, for a given aircraft and mission, the weight of engine plus fuel that would have to be carried. This is obviously the significant weight figure for comparison purposes and Fig. 4 shows that engine plus fuel weight decreases as the by-pass ratio increases; and it continues to do so even at by-pass ratios as high as 2 to 1.

It seems clear, therefore, that the advantage in fuel economy of a high bypass ratio is not offset by the effects of increased engine size and weight.

In addition to its economic advantages, the high ratio ducted fan is said to be very much quieter than the equivalent turbojet. Noise from the jet efflux has been shown to be proportional to the eighth power of its velocity, and the higher the bypass ratio the lower is the efflux velocity and consequently the jet noise. The jet noise from a high ratio ducted fan can be about half that produced by an equivalent turbojet.

However, a high bypass ratio calls for a large fan. As the bypass ratio is increased jet noise decreases and intake noise increases until, at a bypass ratio just greater than 1·8 to 1 (under sea level static conditions), they become equal. Either intake or jet noise may then predominate according to the takeoff flight path.

In the case of the BS75, it is thought that jet noise will be reduced by about 15 dB (perceived



noise) compared with that of an equivalent turbojet, and the intake noise increased by about 3 dB. In consequence, jet and intake noise will be of the same order—one or the other predominating according to the flight path—but in any case there will be a large net reduction in noise under all conditions. Noise levels on the ground under a 3° instrument landing system approach, with engines throttled, will be similar to those experienced with the Caravelle. Engine noise from all sources is the subject of a large programme of research being conducted by Bristol Siddeley and the present indications are that intake noise will be very much easier to silence without loss of efficiency than is exhaust noise.

Another characteristic of the high bypass ratio engine which has bearing on the noise problem is the fact that the ratio of takeoff thrust to cruise thrust increases with increase in bypass ratio. This means that an aircraft powered by a ducted fan with a high bypass ratio, if it has the correct thrust for cruise, will have a substantially higher takeoff and climb thrust than one powered by a turbojet or low bypass ratio engine. This characteristic, apart from its obvious advantage in shortening the takeoff run, also shortens the duration of takeoff noise heard near the airport, because the aircraft gains height more rapidly. It also provides a bonus of thrust which can be very useful in the event of an engine failure.

The layout and detail design of the BS75 are firmly based on Bristol Siddeley experience. It is a two-shaft engine like the Olympus, Proteus and BS53. Like the Orpheus, the basic gas producer has only two main bearings.

The fan is closely related to the first three stages of the low pressure compressor of the Olympus and also embodies experience derived from the BS53. This latter is a high bypass ratio ducted fan engine for military VTOL/STOL aircraft, which has been running at Bristol Siddeley since September, 1959, and has flown successfully in the Hawker P1127 VTOL strike aircraft. Experience with the BS53 has supported Bristol Siddeley thinking on the achievement of high component efficiency in high bypass ratio fans.

COMPRESSOR RESEARCH

The long term programme of compressor research which has been carried out in connection with the Olympus has made it possible to attain pressure ratios exceeding 1·4 to 1 per stage, but the fan of the BS75 has a pressure ratio of only 1·85 to 1 over three stages and it is therefore working well within its capacity.

The compressor is very similar in design to that of the Orpheus but has three extra stages and is slightly scaled down. The stage loading is lower than that of the Orpheus, ten stages being used to provide a pressure ratio of 7 to 1 compared with seven stages for a ratio of 5 to 1.

The combustion system is of the annular type with vapourising burners and this has an enormous background in the Sapphire (Wright J56), of which more than 14,000 have been built. It has also had 15 years of intensive research and development. The more orderly and predictable flow provided by the annular system makes for quick development and long component life.

The turbines are almost identical in size to those of the Proteus, a version of which has achieved an overhaul life of 2,400 hours. The blades are vacuum cast in a cobalt alloy, similar to those which are operating successfully in the Proteus at stresses and temperatures similar to those of the BS75.

There is, therefore, nothing experimental in the engineering sense about the BS75. The Olympus, Sapphire, Orpheus and Proteus have all gained high standards of reliability and there seems to be every reason to suppose that the BS75, so closely related to them mechanically and aerodynamically, will be equally successful. Bristol Siddeley engineers are confident that it will achieve an overhaul life of 2,000 hours within its first 250,000 flight hours.

New Theory for the Heavy Electron

The results have been announced of an experiment to determine the similarity between the muon (or mu meson) and the electron. The experiment, which has take two years to complete, was carried out at CERN, Geneva, under the guidance of Professor Gilberto Bernadini.

The experiment shows that the muon can now, more than ever, be considered as a heavy electron. Results have also confirmed certain laws of physics—quantum electrodynamics—at the very small distances involved in particle physics. Information has also been obtained about the lower limits of the dimension of the muon.

Given the code name " g-2," the first objective of the research programme was to find out to what extent the muon is identical to the electron, in spite of the fact that the muon's mass is 207 times greater. The crux of the experiment was the precise measurement of the magnetic moment of the muon.

It was anticipated that if the muon was a heavy electron showing no interactions different from those of the ordinary electron, then quantum electrodynamics could be used to calculate the muon's magnetic moment precisely. A deviation from this calculated value might entail several explanations, each of which would give a hint as to the real difference between the two sub-atomic particles.

However, if the experiment revealed no deviation from the predicted value, then limitations to the validity of electrodynamics, and other fundamental physical assumptions, would have been established.

The fact that the experiment showed an agreement between theoretical and measured figures within the limits of two parts in 10^6 has led to the following fundamental deductions.

(1) The laws of quantum electrodynamics are valid at very small distances and more precisely down to 0·71 Fermi ($0{\cdot}71 \times 10^{-13}$ cm).

(2) The muon can be visualised as a point-like particle or tiny sphere with a radius of less than 0·3 Fermi.

(3) Any fundamental length which may be introduced as a limit to the relativistic invariance of physics is less than 0·3 Fermi.

The leading members of the international group of research scientists who carried out the experiment were: G. Charpak (France), F. J. M. Farley (Great Britain), R. L. Garwin (USA), T. Muller (France), A. Peterman (Switzerland), J. C. Sens (Holland), V. L. Telgdi (USA), and A. Zichichi (Italy).

Corona Rings for Giant Aerial System

What will be the world's most powerful radio station, now being built for the US Navy, is to be fitted with special stainless steel grading, or corona, rings for use on aerial insulator links. The rings are being made by the Republic Steel Corporation, Ohio, and are believed to be the largest ever made.

The radio station is now being erected on a peninsula in Machias Bay, Maine, for the US Naval communication system, where it will serve particularly to communicate with Polaris-carrying submarines. It is estimated that the entire installation will cost about $70 million.

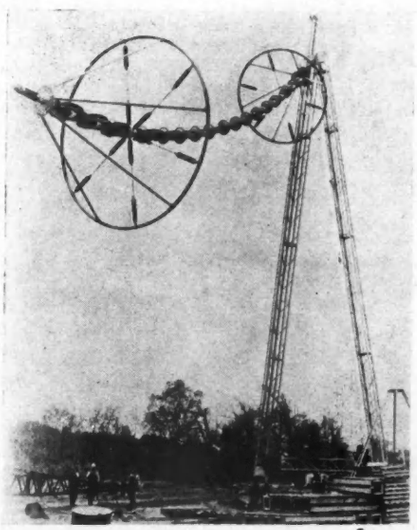
Generally, the station will broadcast with an input power of two megawatts. The power house will be capable of generating 12 megawatts so that de-icing operations may be carried on simultaneously with the powerful very low frequency (VLF) transmission. When completed, early next year, the station will be capable of sending signals throughout the world as well as to submarines anywhere under the sea.

The aerial system of the station consists of 26 supporting towers interconnected by a virtual spider's web of antennae. Each aerial panel is insulated and supported from the towers at each of four points by a chain of insulator links, 74 ft long. In turn, each of these long strings of porcelain insulators is fitted with a pair of the giant grading rings which, when fitted, straddle the insulator as shown in the illustration. These rings form a safe high-voltage gradient so that the station's power is not dissipated in corona losses or arcing. The rings are fabricated in two sizes from stainless steel tubing, which gives them the necessary non-magnetic properties, strength and resistance to corrosion by salt sea air.

The larger of the two corona rings has a 20 ft diameter mouth which pyramids to a steel plate at the other end by six 15 ft legs. The smaller of the two rings is similar in construction with a 15 ft mouth. The open end of the rings is made from 4·5 in outer diameter, 0·165 in wall thickness stainless steel tubing in three sections. The rings were designed by the Lapp Insulator Company of LeRoy, New York and furnished as part of their insulator assemblies. It is reported that no difficulty was experienced in imparting the proper curvature to the tubing. Three attachment fittings, to which turnbuckles and legs are attached, are welded to each section of the tubular circle. The end of each section is flared for the insertion of a stainless steel plug which is used to connect one section of the circle to the next.

When completed, a ring is mounted at each end of every insulator string, so that some 96 corona rings are required for the complete aerial installation. The mouth ends of the rings face each other on the insulator string and are fastened to the insulator links by six shielded barrel turnbuckles. The insulators are necessarily located close to the towers where the voltage gradient is the greatest and where corona losses and arcing would certainly occur if the rings were not used.

The aerials are spread out in two arrays, each having a centre tower 980 ft high, an inner circle of six towers 875 ft high and an outer circle of six towers 800 ft high. There are two aerial arrays that link these towers and, between them, they cover an area of more than 1,200 acres.



Giant voltage-grading, or corona, rings are being constructed for the US Navy's new submarine communication transmitting station.

A Crane Designed from First Principles

Preconceived notions of a crane's structure and ability were discarded when a Dutch company returned to first principles. Each part of the design was reconsidered, resulting in a crane based on rational considerations.

A TECHNICAL team devoted 14 months to studying cranes and present day cargo-handling conditions in various ports. During this time, information was collected from operation engineers, crane drivers and maintenance mechanics.

Towards the end of these studies an industrial artist cooperated with the designers to produce a new-look crane based on practical considerations. The design of all parts down to the smallest detail was considered from first principles both from a theoretical and a practical point of view. The outcome of these investigations resulted in a new series of standardised level-luffing cranes which have a number of novel features. In considering the design, fashionable items which proved of no practical value were discarded.

The cranes, which have a 3 ton hoisting capacity—considered suitable for most port requirements—are known as Leptoptilus and are made by Holland Cranes, PO Box 6058, The Hague, Holland. They have been tried out by one of the leading Amsterdam shipping companies and it is claimed they have satisfied the most stringent requirements.

Formed from box section, the gantry legs carry the necessary ballast inside. Both users and designers agreed that four legs offer the best operating conditions particularly in regard to stability and wheel pressures on the quay. Because of the shape of the legs no water or dust collects and where chemicals are handled this is of prime importance. Absence of horizontal connecting beams gives free access in every direction under the crane.

For propelling the crane, two of the four bogies have self-contained units attached, which can easily be dismounted for inspection. Each unit is fitted with a shock absorber.

One useful feature of the crane is the fact that the jib can be luffed down to the quay very easily (Fig. 2). To do this the operator has only to release two bolts and push in the button of the bypass switch of the luffing limit device. Because the jib can be dropped so easily, it follows that there is no difficulty in inspecting sheaves and ropes, it is easy to weave new ropes and the jib itself will receive more attention resulting in added life.

Even with the most experienced operators working the crane, the jib can become damaged. Bearing this in mind, Hollands deliberately decided to adopt a riveted construction for the jib so that should an accident occur, it can more easily be repaired on the spot. As can be seen from Fig. 1, the tail ends of the jibs of adjacent cranes cannot touch each other.

Counterweights for types LP 320 and LP 322 are in the tail of the jib. But the LP 328 type has a loose counterweight suspended from wirelines on sheaves which still allows for the jib to be completely luffed down to the ground without extra manipulation.

Like the mechanism for travelling, luffing and slewing, the hoisting mechanism has been constructed as a self-contained unit. The unit consists of an electric motor with built-in brake (which operates as soon as current is closed), and a flexible coupling. Space is saved by the reduction gears being fitted inside the hoisting drum. The unit can easily be dismounted and transported for overhaul purposes.

The Leptoptilus Range

Type	Hoisting capacity (tons)	Radius (ft) Max	Min
LP 320	3	65	20
LP 322	3	72	21
LP 325	3	82	21
LP 328	3	92	23

Weight of the load can be read by the operator on an indicator of the vibrometer type which the makers claim gives a reading of 98 per cent accuracy. The indicator also acts as an overload device.

The slewing mechanism is also designed as a self-contained unit. The upper structure slews on and is carried by a ball race with two layers of balls for taking up pressure and pull. Because of this, no ballast in the slewing structure is necessary, thus saving weight and space.

Made of sheet steel, the tower is in the shape of a box section. It contains the electrical apparatus and the wiring, which need not be dismantled for transport purposes. Easy assembly upon arrival results. Because of the funnel type construction, there is good ventilation.

Completely built as a single unit, the luffing mechanism is attached to the tower at three points (Fig. 3 gives some idea of the jib's versatility). It is easy to inspect and to dismount when required and shock absorbers prevent extreme shock loads especially when starting and stopping thus causing less wear. The toothed luffing segments—which are on the left of the jib—are driven by pinions which are accurately positioned and adjusted to obtain perfect mesh with the segments.

Speeds for travelling, slewing and hoisting were the subject of a special survey and time studies of numerous cycles of operation were made. Time losses and their causes were closely scrutinised. All this has resulted in the various speeds for the crane being determined so that a skilled crane driver can obtain maximum efficiency without undue fatigue.

The operator has a well designed chair and the controls are situated to give a comfortable working position. Abundance of windows gives him a panoramic view of the quay and ship.

The range of cranes is available for ac and dc currents. For occasional lifts of up to 5 tons, the makers say that after minor modifications, type LP 328 can be used at a maximum radius of 56 ft. The table on this page shows the range of cranes and their minimum and maximum working radii.

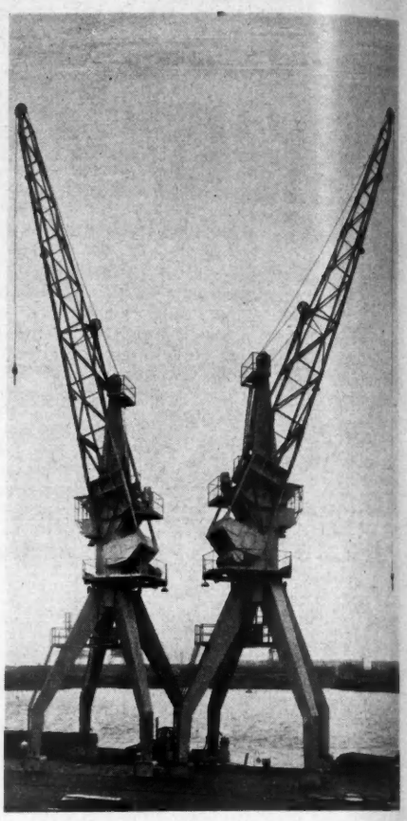


Fig. 1 The Leptoptilus range of level-luffing cranes have been designed from a newly considered theoretical and practical point of view. As can be seen, the tail ends of the jibs of adjacent cranes cannot touch each other.

Fig. 2 Because it is an easy matter to lower the jib there is little difficulty in inspecting the sheaves and ropes or in carrying out repairs.

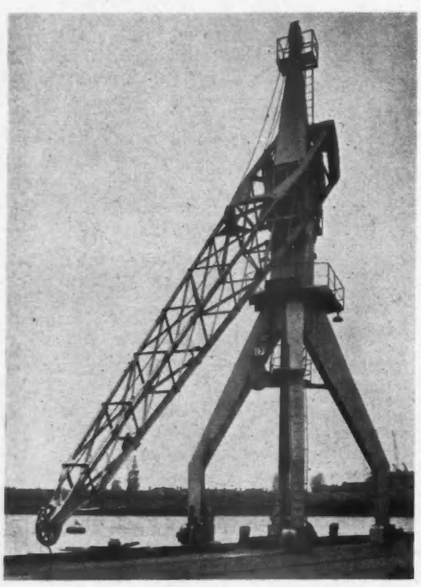
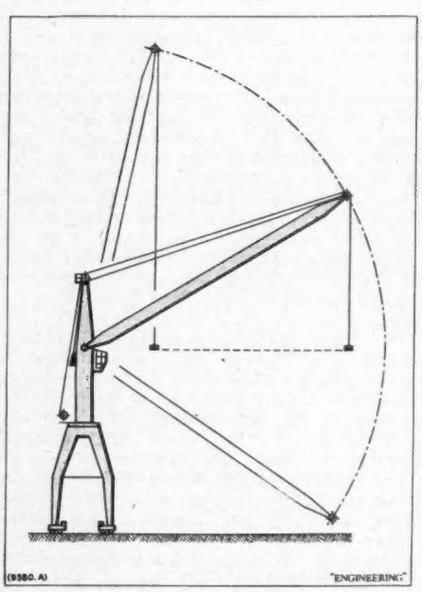


Fig. 3 Speeds for travelling, slewing and hoisting were the subject of a special design study. Some idea of the jib's versatility is shown here.



Petrol Pump Gives Immediate Choice

The best of motorists are impatient beings, not only on the road but when waiting to be served with fuel at the filling station. Autovista, a new system for dispensing fuels, has been introduced by the British Petroleum Company as a means of reducing time spent at, and simplying the operation of, filling stations.

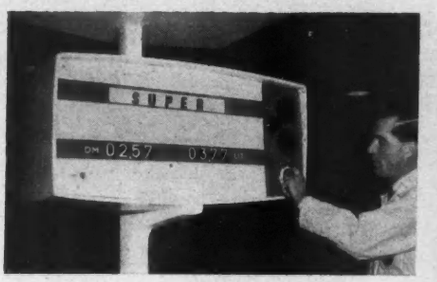
Instead of the conventional one-piece petrol pump where dials and hose are together, the Autovista has been separated into two distinct units. The dials are positioned so that the motorist can see the quality, quantity and price of his petrol without leaving the car. The hose unit is some feet behind so that the attendant does not have to take the hose round to the rear of the car.

Various grades of fuel can be dispensed from one unit by pre-setting dials which not only give fuel by volume but also by money value. In countries where BP supplies blended grades the Autovista will dispense a whole range up to 5 grades of petrol. Flow is automatically cut off when the selected amount has been reached.

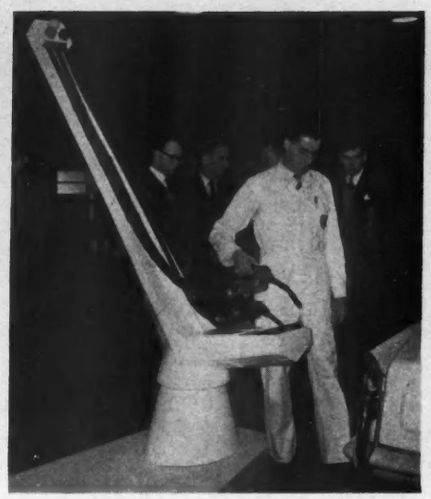
A conventional pump consists basically of a pumping unit, air separator and meter. The meter shaft drives an indicator system which shows the volume and in some types computes the money value by means of a series of gear trains from which different ratios corresponding to changes in price can be selected.

Autovista employs any of the conventional pumping and meter systems, but the rotation of the meter spindle is used to generate two trains of electric pulses by means of photo-electric scanners which read units of price and volume independently. The two pulse streams are then led through electronic circuits which reform the pulse shapes and amplify them. These pulses are then fed into separate channels which control the following: volume indicator, total price indicator, volume pre-set, price pre-set, grade or blend control and pre-set valves.

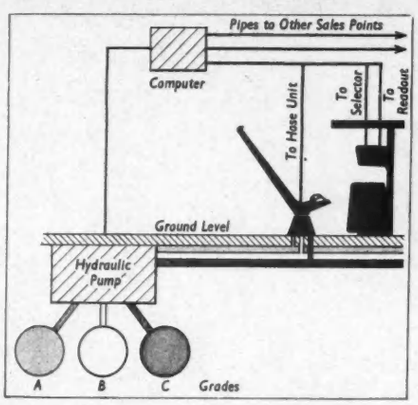
The selector switch allows the operator to pre-select the required grade of fuel as well as additional fuels such as diesel or two-stroke mixture. Movement of this selector switch initially rotates the grade panel and in so doing operates the actual grade selection. After further selection of the required volume or price pre-setting, the removal of the holster of the trigger nozzle initiates the necessary valve setting and the starting of the motor to drive the appropriate pump.



(Above) By setting the dials of the BP Autovista, the hose unit can deliver fuel by volume or to any value of money as well as giving a choice in the grade of fuel.



(Right) The boom on the hose unit rotates so that the hose itself can be kept clear of the car. Full flow rate is maintained until the selected quantity of fuel has been delivered.



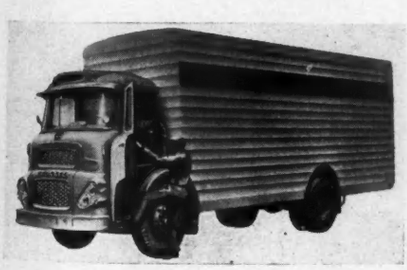
(Below right) The only connection between the hydraulic system, the electronic control system, the money and volume dials and the selector panel are multiple electrical cables. The positioning of any of these units is therefore flexible.

Because the only connections between the hydraulic system, the electronic control system, the money and volume dials and the selector panel are multiple electrical cables, the positioning of any of these units is flexible. In addition to the electrical connections, the pumping meter and hoses can also be separated, within reason, by suitable lengths of pipework.

Since both the volume and money values of each operation are represented by electrical pulses, these can be fed into ticket printers, additional remote readouts and accounting equipment and may be transmitted to supply depots for the programming of supply deliveries.

The contract for the development and manufacture of the Autovista was placed with the de Havilland Engine Company. The unit illustrated is destined for Germany but others will be installed in the UK and Italy within the next three or four months.

Range of Trucks Designed for the Common Market



Two of a range of Belgian made trucks, fitted with Leyland engines, which have been designed to meet the proposed transport regulations of the Common Market.

Trucks which have been designed to meet the proposed transport regulations of the European Common Market are now being manufactured by the Belgian company Brossel Frères SA of Brussels. They are described as high-performance vehicles and are fitted with Leyland Power-Plus diesel engines of up to 200 hp.

The range, which is to be known as the "Europ," covers 15 basic models with wheelbases varying in five sizes from 3 m to 5·2 m. Trucks, tippers and tractors are to be included.

Following an extensive market survey undertaken in Belgium and other European countries, the company felt that there was a market for a Belgian built truck, with a high powered, economical diesel engine with the cab over the engine. They also felt that the gross solo weight (vehicle with body and load) should be from 12 to 19 metric tons and gross train weights (vehicle and trailer(s) with their bodies and loads) should be from 20 to 32 metric tons.

The appearance of these vehicles is very similar to Leyland's own range of Power-Plus trucks. Brossels have always had a close affinity with Leylands in that they have installed Leyland engines in their trucks and buses, and the Europ range will continue this tradition. The engines, incorporating the spheroidal combustion chamber, produce 33 per cent more power than the previous units of the same size and are 4 to 10 per cent more economical in fuel.

This is the first time Leyland have allowed the installation of their Power-Plus engines in any competitive make of vehicle. To ease the initial load of manufacture in the assembly and machine shops at Brossels, a number of British and German components will be used in the models.

One of the interesting features of the new models is a reinforced-plastic cab, which consists of a strong steel sub-frame with glass-fibre panels. It is corrosion proof and because of its high impact strength, provides a good safety factor. Driver comfort—a strong selling point these days—is well provided for, with heater, demister, wind-screen washer, exterior sun-visor and other accessories being fitted.

Power assisted steering can be fitted to all models. Vehicles under the classification "A" in the light range are fitted with brakes boosted by an air pressure system. All other vehicles have brakes actuated by a cam and air-boosted diaphragm adjacent to each brake drum, pressurised by a two-cylinder engine-driven compressor. The handbrake is power assisted.

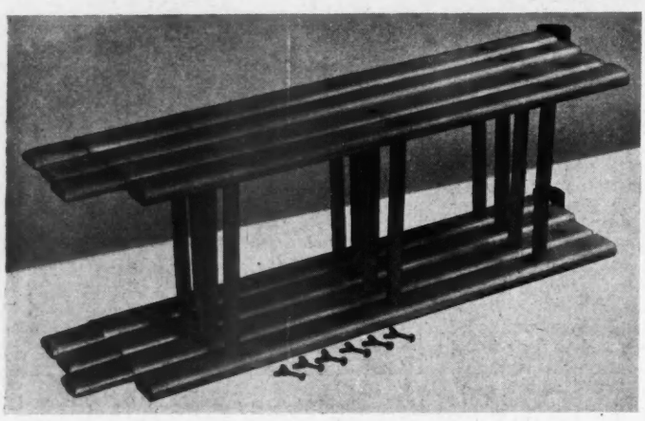
Aluminium Makes Light Work

ONE of the roles of the housewife which is perhaps least known to herself but well known to her husband is that of being the dictator of fashions. One has only to think of the way the motor car designer has pandered to her whims and fancies to know that this is true. However, in the end, the whole household benefits from her discerning adventurousness.

Of all the materials introduced into the home, aluminium has probably served the housewife as well as any. The properties of this comparatively young metal are known to all: lightness, strength, durability, as well as good electrical and thermal conductivity. The number of foot-pounds of work which must have been saved by using aluminium cooking utensils and other appliances must be very high. It is estimated, for instance, that if an aluminium electric iron is used in place of a steel one—it usually weighs about 2 lb less—something like 2 tons of ironing effort is saved in a week's work. In addition, a more even spread of heat and a shorter heating up period mean that the ironing is done more quickly, with less effort and using less electricity.

Finishes have undergone considerable development. Aluminium can be colour anodised, stove enamelled, or painted to harmonise with existing colour schemes. It can also be laminated to plastics, which affords fresh scope in the design of lightweight dining room and bedroom furniture. (Furniture design was dealt with at some length on pages 130-31 of our 20 January, 1961, issue.)

(*Above*) *Many branded foods are pre-cooked in their own aluminium foil packages, which when heated can be used as a serving dish.*



(*Left*) *Aluminium seems an obvious choice for a ladder, with its high strength-to-weight ratio. This one is sectional and is made from 2 in by 1 in tube.*

It is of course in the kitchen—as with so many other things—that aluminium is on view more than anywhere else in the home. Because of the many processes which originate there and because of the time spent within it, the kitchen and its contents should represent the ultimate in design. Aluminium has helped to make this true. Aesthetically the modern kitchen is often one of the brightest rooms in the house due to the use of varying surface finishes in the manufacture of totally enclosed cabinets, sink units, washing machines, refrigerators and dish washers. Door knobs and stools among other items can be anodised to match.

Mention has already been made of the electric iron made from aluminium, but other equipment is also made of this material to save weight, such as food mixers, preserving pans and vacuum cleaners. Washing machines are often constructed from aluminium not only to reduce weight, but also because of the metal's high resistance to corrosion.

It is not only in the preparation of food that aluminium is used but also for its cooking and packaging. A joint of meat, a piece of ham or any kind of poultry brushed lightly with melted fat and wrapped in aluminium foil cooks without basting and emerges very tender and with the full flavour retained. Such foil is greaseproof, moistureproof, non-toxic, non-inflammable and non-adhesive. Being easy to work, it can be moulded into any required shape. When used for such foods as fish and onions, aluminium foil effectively provides an odour barrier. Many branded foods are now pre-cooked in their own foil packages which, when heated can be used as a serving dish. Such a range from America is shown in the upper illustration.

The Aluminium Development Association, in *The Aluminium Courier*, drew attention last year to the expansion that has come about in the post-war years in the use of aluminium both for the house and the garden. It is not difficult to see evidences of this and the do-it-yourself market has added to the trend. What more obvious example of the excellent strength-to-weight ratio of aluminium can be found than in a ladder? People who are constantly working about the house, both inside and out, can readily appreciate the value of a light and strong ladder and an example by H. C. Slingsby Limited, 89 Kingsway, London, WC2, is shown above. It is sectional and is made from 2 in by 1 in tube.

We have dealt mainly with the interior of the house, but aluminium's excellent non-corrosive nature has given it numerous external applications, such as window frames, garage doors and garden furniture. Aluminium roofs are now commonplace and foil insulation is in the lofts of many homes.

Let the final word go to the little groups who adorn our doorsteps each morning—the milk bottles. Foil to the tune of about 5,000 tons is used in capping the year's supply for Great Britain.

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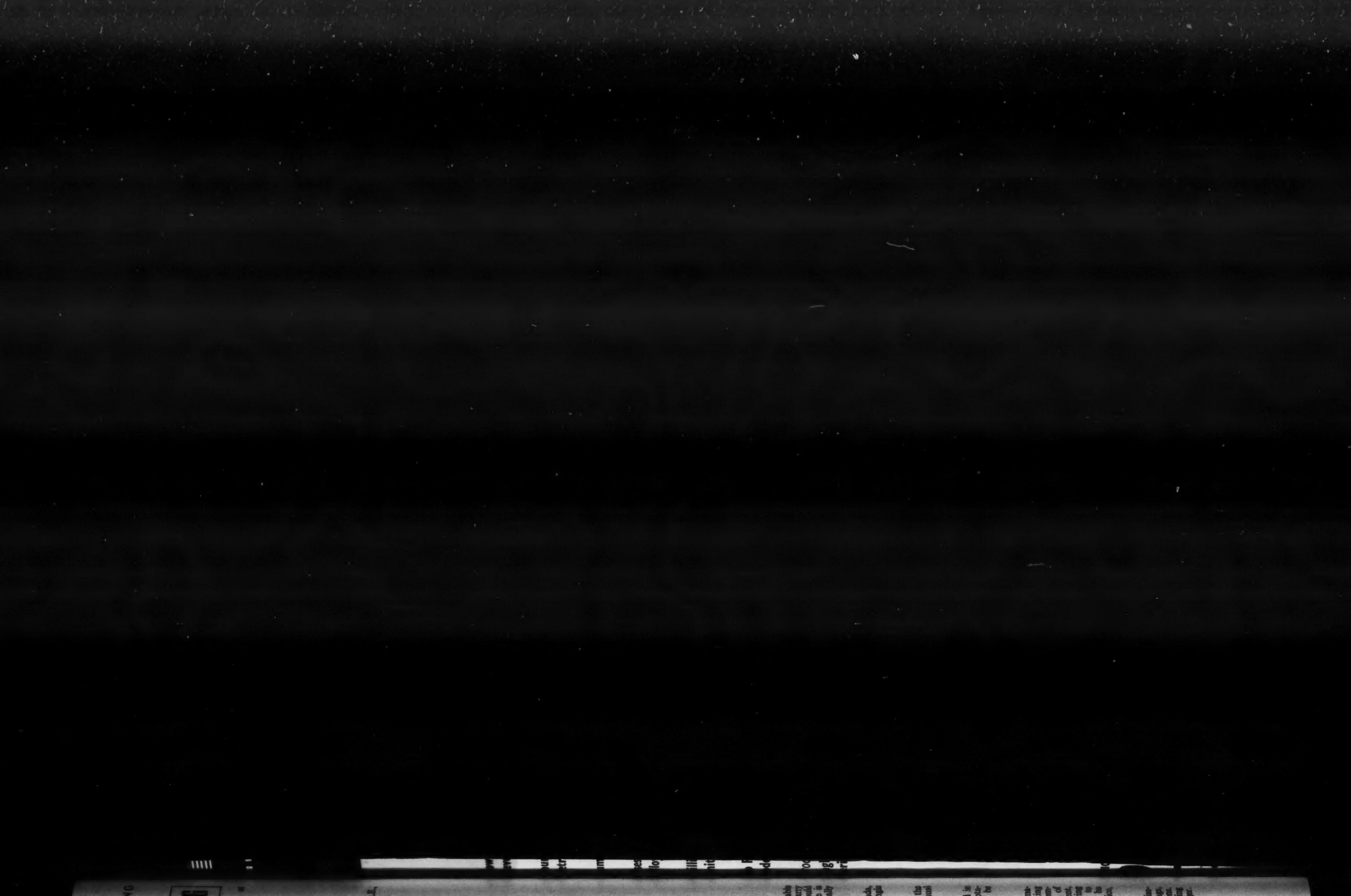
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